Intellectual Property and Consumer 3D Printing

by

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Declaration

I, Bram Van Wiele, hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university. I authorise the University to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.

Signature: Signed by candidate Date: 30 November 2018

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Abstract

Disruptive technologies influence the application and development of intellectual property. Additive manufacturing, colloquially known as 3D printing, is one such technology that has a profound impact on how goods are created, disseminated and consumed. This technology enables, in an unprecedented matter, the decentralised manufacturing of goods, supplemented by user-based creation and instantaneous dissemination of the underlying digital models.

From the perspective of intellectual property law, the focus of this thesis is on analysing of how consumer 3D printing creates legal ambiguity and enforcement issues that affect a multitude of actors, in interrelated, conflicting and potentially overlapping capacities. It focusses on the intellectual property regimes that are at the forefront of 3D printing, including the laws of trade marks, copyright, patents and designs. Emphasis of this thesis is on the law of South Africa; however, in the absence of judicial guidance, an examination of the laws of the United Kingdom and the European Union provides additional insights and guidance. The development of arguments in this work is grounded in technological and social premises, determined by the characteristics of the consumer 3D printing ecosystem and the additive manufacturing process, including design creation, dissemination and production.

The underlying research question of this thesis is how the intellectual property framework can be used and further optimised to promote consumer 3D printing. In this context, it investigates how the interests of the following key actors can be balanced: (i) rights holders that typically wish to control design dissemination; (ii) design sharing platforms that seek to facilitate design creation and dissemination; and (iii) consumers who require access to digital designs.

This thesis submits that a balance can indeed be struck, subject to complementary actor- and situation specific responses. In addition to these responses, this thesis proposes minor amendments to the current South African intellectual property framework, supplemented by the clarification concerning the application of intellectual property rights, and the implementation of non-restrictive digital rights management systems.

Table of Contents

Chapter Six: Responding to Consumer 3D Printing

Chapter Seven: Conclusion and Recommendations

Table of Figures

Table of Abbreviations

Acronyms

2D.....Two-Dimensional
3D.....Three-Dimensional
3MF.....3D Manufacturing Format (file format)
AM.....Additive Manufacturing
AMF.....Additive Manufacturing File Format
ASTM.....American Society for Testing and Materials
CAD.....Computer Aided Design
CBPP.....Commons-based Peer Production
CC.....Creative Commons
CCPA.....Court of Customs and Patent Appeals
CCPL.....Creative Commons Public License
CG.....Computer Generated
CIPC.....Companies and Intellectual Property Commission
CJEU.....Court of Justice of the European Union (formerly ECJ)
CLIP.....Continuous Liquid Interface Production
CMI.....Copyright Management Information
COSNU.....Capable of Substantial Non-Infringing Uses
DIY.....Do-It-Yourself
DLT.....Distributed Ledger Technology
DLP.....Digital Light Processing
DTI.....Department of Trade and Industry
EBM.....Electron Beam Manufacturing
ECJ.....European Court of Justice (see CJEU)
EPO.....European Patent Office
EU.....European Union
EUIPO.....European Union Intellectual Property Office (formerly OHIM)
EULA.....End-User License Agreement
FDL.....Free Documentation Licence
FDM.....Fused Deposition Modelling
FFF.....Fused Filament Fabrication
FOSS.....Free and Open-Source Software
GPL.....General Public Licence
IP.....Intellectual Property
IPO.....Intellectual Property Office
ISO.....International Organization for Standardization
ISP.....Internet Service Provider
LOM.....Laminated Object Manufacturing

MJ ..... Material Jetting
MJF ..... Multi Jet Fusion
MPAA ..... Motion Pictures Association of America
OECD ..... Organisation for Economic Co-operation and Development
OHIM ..... Office for the Harmonization of the Internal Market (see EUIPO)
OSP ..... Online Service Providers
P2P ..... Peer-to-Peer
RMI ..... Rights Management Information
SA ..... South Africa
SCA ..... Supreme Court of Appeal (South Africa)
SLA ..... Stereolithography (manufacturing process)
SLM ..... Selective Laser Melting
SLS ..... Selective Later Sintering
SMME ..... Small, Medium and Micro Enterprises
STL ..... Stereolithography (file format)
TPM ..... Technical Protection Measure
UAM ..... Ultrasonic Additive Manufacturing
UCD ..... Unregistered Community Design
UDR ..... Unregistered Design Right
UGC ..... User-Generated Content
UK ..... United Kingdom
US ..... United States (of America)
VRML ..... Virtual Reality Modelling Language (file format)
WIPO ..... World Intellectual Property Organization

Journals

AIPJ ..... Australian Intellectual Property Journal
AIPLA QJ ..... American Intellectual Property Law Association Quarterly Journal
Akron L Rev ..... Akron Law Review
Ariz St LJ ..... Arizona State Law Journal
Berkeley Tech LJ ..... Berkeley Technology Law Journal
Brook L Rev ..... Brooklyn Law Review
Bus L R ..... The Business Law Reports
Can Intell Prop Rev ..... Canadian Intellectual Property Review
Cardozo Arts & Ent LJ ..... Cardozo Arts & Entertainment Law Journal
CBLJ ..... Canadian Business Law Journal
Chi-Kent J Intell Prop ..... Chicago-Kent Journal of Intellectual Property
CMLR ..... Common Market Law Reports
Colum JL & Arts ..... Columbia Journal of Law and the Arts
Columb L Rev ..... Columbia Law Review
CILSA ..... Comparative and International Law Journal of South Africa
CTLJ ..... Colorado Technology Law Journal

CTLR ..... Computer and Telecommunications Law Review
ECDR ..... European Copyright and Design Reports
EIPR ..... European Intellectual Property Review
EJLT ..... European Journal of Law and Technology
Ent L R ..... Entertainment Law Review
Emory LJ ..... Emory Law Journal
Geo LJ ..... Georgetown Law Journal
Geo Mason L Rev ..... George Mason Law Review
Geo Wash L Rev Arguendo ..... George Washington Law Review Arguendo
GRUR Int ..... Gewerblicher Rechtsschutz und Urheberrecht, Internationaler Teil
Hastings LJ ..... Hastings Law Journal
Harv Bus Rev ..... Harvard Business Review
Harv JL & Tech ..... Harvard Journal of Law & Technology
Harv L Rev ..... Harvard Law Review
High Tech L ..... Journal of High Technology Law
IIC ..... International Review of Intellectual Property and Competition Law
IJLILS ..... International Journal of Law and Interdisciplinary Legal Studies
IJLIT ..... International Journal of Law and Information Technology
IPJ ..... Intellectual Property Journal
IPQ ..... Intellectual Property Quarterly
JEP ..... Journal of Economic Perspectives
JIPEL ..... New York University Journal of Intellectual Property and Entertainment Law
JIPITEC ..... Journal of Intellectual Property, Information Technology and Electronic Commerce Law
JIPLP ..... Journal of Intellectual Property Law & Practice
JLIS ..... Journal of Law, Information and Science
J Marshall R Intell Prop L ..... John Marshall Review of Intellectual Property Law
LCP ..... Law and Contemporary Problems
LIM ..... Legal Information Management
Fla L Rev ..... Florida Law Review
Fordham Intell Prop Media & Ent LJ ..... Fordham Intellectual Property, Media & Entertainment Law Journal
FSR ..... Fleet Street Reports
Mich L Rev ..... Michigan Law Review
Minn L Rev ..... Minnesota Law Review
Minn JL Sci & Tech ..... Minnesota Journal of Law, Science & Technology
MIT SMR ..... MIT Sloan Management Review
NCJL & Tech ..... North Carolina Journal of Law & Technology
NC L Rev ..... North Caroline Law Review
Notre Dame L Rev ..... Notre Dame Law Review
Nw J Tech & Intell Prop ..... Northwestern Journal of Technology and Intellectual Property
NYU L Rev ..... New York University Law Review
OJLS ..... Oxford Journal of Legal Studies
RPC ..... Reports on Patent, Design and Trademark Cases

SAJIC ..... Southern African Journal of Information and Communication
SALJ ..... South African Law Journal
San Diego L Rev ..... San Diego Law Review
Santa Clara Computer & High Tech LJ ..... Santa Clara Computer and High Technology Law Journal
Santa Clara L Rev ..... Santa Clara Law Review
Stanford L Rev ..... Stanford Law Review
Theoretical Inquiries L ..... Theoretical Inquiries in Law
TMR ..... The Trademark Reporter
U Balt L Rev ..... University of Baltimore Law Review
U Ill L Rev ..... University of Illinois Law Review
UC Davis Law Review ..... UC Davis Law Review
UCLA L Rev ..... University of California at Los Angeles Law Review
USF L Rev ..... University of San Francisco Law Review
Vand J Ent & Tech ..... Vanderbilt Journal of Entertainment & Technology Law
W Va L Rev ..... West Virginia Law Review
Wash & Lee L Rev ..... Washington & Lee Law Review
Wash L Rev ..... Washington Law Review

Legislation

International

'Berne Convention'	Berne Convention for the Protection of Literary and Artistic Works, adopted Paris Act of 24 July 1971, as amended on 28 September 1979.
'Nice Agreement'	Nice Agreement Concerning the International Classification of Goods and Services for the Purposes of the Registration of Marks.
'Paris Convention'	Paris Convention for the Protection of Industrial Property, Stockholm act 14 July 14, 1967, as amended on 28 September 1979.
'Rome Convention'	International Convention for the Protection of Performers, Producers of Phonograms and Broadcasting Organizations, Rome, 26 October 1961.
'TRIPS Agreement'	Agreement on Trade-Related Aspects of Intellectual Property Rights of 15 April 1994.
'UDHR'	Universal Declaration of Human Rights of 1948.
'**WCT'**	WIPO Copyright Treaty and Agreed Statements Concerning the WIPO Copyright Treaty, adopted in Geneva on 20 December 1996.
'WPPT'	WIPO Performances and Phonograms Treaty, adopted in Geneva on 20 December 1996.

European Union

'Agreement on a Unified Patent Court'	Council Agreement on a Unified Patent Court [2013] OJ C 175/1.
'Community Designs Regulation'	Council Regulation (EC) 6/2002 of 12 December 2001 on Community Designs [2002] OJ L 3/1.
'Community Designs Implementation Regulation'	Commission Regulation (EC) 2245/2002 of 21 October 2002 Implementing Council Regulation (EC) No 6/2002 on Community Designs [2002] OJ L 341/28.
'Computer Program Directive'	Directive 2009/24/EC of the European Parliament and of the Council of 23 April 2009 on the legal protection of computer programs [2009] OJ L 111/16.
'Designs Directive'	Directive 98/71/EC of the European Parliament and of the Council of 13 October 1998 on the legal protection of designs [1998] OJ L 289/28.
'E-Commerce Directive'	Directive 2000/31/EC of the European Parliament and of the Council of 8 June 2000 on certain legal aspects of information society services, in particular electronic commerce, in the Internal Market [2000] OJ L 178/1.
'EU Trade Marks Regulation'	Council Regulation 2017/1001 of the European Parliament and of the Council of 14 June 2017 on the European Union Trade Mark [2017] OJ L 154/1.
'European Patent Convention'	The Convention on the Grant of European Patents of 5 October 1973.
'InfoSoc Directive'	Directive 2001/29/EC of the European Parliament and of the Council of 22 May 2001 on the harmonisation of certain aspects of copyright and related rights in the information society [2001] OJ L 167/10.
'Trade Marks Directive'	Directive (EU) 2015/2436 of the European Parliament and of the Council of 16 December 2015 to Approximate the Laws of the Member States Relating to Trade Marks [2015] OJ L 336/1.
'Unitary Patent Regulation'	Regulation 1257/2012 of the European Parliament and the Council of 17 December 2012 on Implementing Enhanced Cooperation in the Area of the Creation of Unitary Patent Protection, [2012] OJ L 361/5.

National

'CDPA'	–	Copyright, Designs and Patents Act of 1988	(UK)
'Copyright Act '	–	Copyright Act 98 of 1978	(SA)
'Designs Act'	–	Designs Act 195 of 1993	(SA)
'DMCA'	–	Digital Millennium Copyright Act	(US)
'ECT Act'	–	Electronic Communications and Transactions Act	(SA)
'IP Act'	–	Intellectual Property Act 2014	(UK)
'Patents Act'	–	Patents Act 57 of 1978	(SA)
'Patents Act'	–	Patents Act 1977	(UK)
'RDA'	–	Registered Designs Act of 1949	(UK)
'Trade Marks Act'	–	Trade Marks Act 193 of 1994	(SA)
'Trade Marks Act'	–	Trade Marks Act 1994	(UK)
'USC'	–	United States Code	(US)

Introduction

'3D printing opens up new frontiers. Manufacturing and business as usual will be disrupted as regular people gain access to power tools of design and production. Intellectual property law will be brought to its knees.'[1]

Problem Review

Digitisation has shaped how goods are created, disseminated and consumed. It provides new means for creative expression, enables new business models (while disrupting older ones), and challenges the application and the development of intellectual property rights frameworks.[2] 3D printing, formally known as additive manufacturing (AM),[3] connects the digital to the physical world and emerges as a transformative, disruptive technology for creativity, innovation and intellectual property. The last decade has been characterised by a considerable amount of hype surrounding 3D printing[4] accompanied by fear of 'democratised piracy' that undermines intellectual property rights.[5] While the capabilities of consumer 3D

[1] H Lipson and M Kurman, *Fabricated: The New World of 3D Printing* (Wiley 2013) 7.

[2] Most notably, copyright has been shaped by the emergence of new technologies. See Committee on Intellectual Property Rights, Computer Science & Telecommunications Board, *The Digital Dilemma: Intellectual Property in the Information Age* (National Academy Press, Washington, 2000); J Litman, *Digital Copyright: Protecting Intellectual Property on the Internet* (Prometheus 2001); L Jones, 'An Artist's Entry Into Cyberspace: Intellectual Property on the Internet' (2000) 22(2) EIPR 79–92; A Laing, 'Copyright in the Age of Mass Digitisation' (2006) 17(5) Ent L R 133–38; Z Efroni, *Access-Right: The Future of Digital Copyright Law* (2011 OUP); S Stokes, *Digital Copyright Law and Practice* (4th edn, Hart 2014).

[3] There are various terms in use that describe (characteristics of) this process. See I Gibson, D Rosen and B Stucker, *Additive Manufacturing Technologies* (2nd edn, Springer 2015) 7–9. This work uses the term '3D printing', while recognising that various manufacturing processes are not 'printing' processes in the strict sense.

[4] For instance, many of the newspaper articles on the subject are based on individual success stories or neglect to differentiate between consumer and industrial applications. The Garner hype cycle, which represents maturity, adoption and social application of specific technologies, shows that consumer 3D printing has only now gone through its peak of inflated expectations. See Gartner, 'Hype Cycle for Emerging technologies' (2017) <https://www.gartner.com> accessed 30 November 2018.

[5] An increasing body of literature describes the risk that 3D printing poses for intellectual property rights. See 'Secondary Sources'.

printing remain debated,[6] the increasing availability of digital models, complemented by growing accessibility to hardware,[7] and tangible intellectual property implications[8] indicate 3D printing's disruptive impact.

3D printing technology democratises both manufacturing and the design creative process. It enables end-user appropriation of the manufacturing process by facilitating a largely decentralised manufacturing model. Rather than producing goods centrally and distributing them around the world, the technology facilitates decentralised manufacturing based on the distribution of digital models that embed the respective designs. At the same time, the digital nature of these models allows for easy creation, adaptation, modification and customisation, and their subsequent effortless and instantaneous distribution via online platforms.[9] The result is that

> 3D printing technology has the potential to open up a vast commons of inventive ideas, stocked with user-generated innovations. […] Growth of this commons, and the preservation of the knowledge users commit to it, should be a priority for members and supporters of this growing community of user-innovators.[10]

For consumers the technology holds the promise of limitless access to countless digital designs, which can be produced in the privacy of their homes. It has been estimated that 3D printing could have an global economic impact of between US$ 230 billion and US$ 550 billion per year by 2025,[11] with the largest growth attributable to consumers and users.[12] In fact, desktop 3D printers are now moving

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[6] Initially 3D printing was considered as a prototyping tool based on extrusion-based printing processes; however, at the time of writing, various other 3D printing technologies have become available on the consumer market.

[7] Accessibility includes affordability of personal 3D printers and access to on-demand printing services. M Raskin and I Kolet, 'Personal 3-D Printer Sales Jump 35,000% Since 2007' (*Bloomberg*, 24 October 2012) <https://www.bloomberg.com/news/2012-10-24/personal-3-d-printer-sales-jump-35-000-since-2007.html> accessed 30 November 2018.

[8] For instance, the unauthorised sharing of digital designs has led designers and hosting websites to have received cease-and-desist letters and takedown notices. See 1.2.3 – The Status of Consumer 3D Printing .

[9] The platforms Thingiverse, GrabCab, Shapeways and The Pirate Bay are discussed in 1.2.2 – Actors.

[10] D Davis, 'Downloading Infringement: Patent Law as a Roadblock to the 3D Printing Revolution' (2012) 26(1) Harv J L & Tech 353, 371. See also H Kyriakou, S Englehardt and JV Nickerson 'Networks of Innovation in 3D Printing' (2014) Howe School of Technology Management Research Paper Number 2014-3 <available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2146080> accessed 30 November 2018.

[11] McKinsey Global Institute, 'Disruptive technologies: Advances that will transform life, business, and the global economy' (2013) 105, 110 <https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/disruptive-technologies> accessed 30 November 2018.

[12] The impact of consumer users is estimated at US$ 100 to 300 billion. ibid.

into the mass consumer market[13] and 3D printing services provide on-demand production of individual and third party designs.

However, it has been notated that '[n]ew technologies often have disruptive effects on existing systems of [intellectual property] and the production and distribution of content.'[14] In bridging the gap between the digital and physical world, 3D printing interrelates with many aspects of intellectual property law, including trade marks, designs, patents and copyright. As with many new technologies there is currently significant uncertainty about the applicability, suitability and enforceability of the current laws. Old business models are also increasingly challenged by the 'decentralised materialisation of the digital world' and new business models are built around it.[15] Intellectual property law, and specifically copyright law, has always been shaped by the development of new technologies. From the printing press in the late 15th century to the digitisation of music and books, these developments have been seen as threats to those who base their existence on pre-existing technology. This aversion of new technologies has led to various attempts to curb their use through both legal and technological means.[16] 3D printing faces similar challenges due to its potential to seriously threaten those who have built their business model around the exclusive creation and dissemination of intellectual property protected goods.[17]

It has been predicted that as 3D printing becomes more widespread amongst consumers, it could threaten the design and manufacturing industry in the way

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[13] Wohlers Associates, 'Wohlers Report 2016: 3D Printing and Additive Manufacturing State of the Industry Annual Worldwide Progress Report' (Wohlers Associates, 2016). The production of personal 3D printers by large companies can be a catalyst for widespread consumer use. Most notably, in 2018, technology giant Apple was granted a patent for a full-color 3D printing system. US patent no. 9,868,294. Over the past years, Apple had already applied for various 3D printing-related patents. See R Haria, 'Apple 3D Printer Patent Granted, Full Color 3D Printing System' (3D Printing Industry, 17 January 2018) <https://3dprintingindustry.com/news/apple-full-color-3d-patent-127565> accessed 30 November 2018.

[14] CW Finocchiaro, 'Personal Factory or Catalyst for Piracy: The Hype, Hysteria, and Hard Realities of Consumer 3-D Printing' (2012) 31 Cardozo Arts & Ent LJ 473, 480.

[15] DR Desai, 'The New Steam: On Digitization, Decentralisation, and Disruption' (2014) 65 Hastings L J 1469; MA Lemley, 'IP in a World Without Scarcity' (2015) 90(2) NYU L Rev 460.

[16] In the 15th century, authorities tried to control printing by appropriating the exclusive right of printing- so-called 'printing priveleges'. See generally R Deazley, *On the Origin of the Right to Copy: Charting the Movement of Copyright Law in Eighteenth Century Britain* (1695-1775) (Hart 2004). R Deazley, *Re-thinking Copyright: History, Theory, Language* (Edward Elgar 2006). On restricting contemporary technologies through legal means see footnote 2.

[17] Gartner, an American research and advisory firm, predicts that 3D printing will lead to an annual loss of 100 billion USD to intellectual property holders globally. Gartner, 'Gartner Says Uses of 3D Printing Will Ignite Major Debate on Ethics and Regulation' (2014) <https://www.gartner.com/newsroom/id/2658315> accessed 30 November 2018.

Napster did for the entertainment industry.[18] In the expectation of 3D printing soon becoming a mass phenomenon, proposals for strengthening intellectual property laws have been put forward by many commentators[19] and were included in various policy documents.[20] At the same time, other scholars caution that more restrictive legislation could cripple this technology and its use.[21] Interestingly, even companies heavily depending on intellectual property, like IBM, have advised policy makers to '[p]repare for [intellectual property] reform and digital rights management by protecting businesses but *balance this with enabling innovation by disruptive technologies and open source platforms* […].'[22]

History shows that established businesses typically not only seek relief by advocating more restrictive legislation, but also by enforcing their rights more aggressively.[23] When digital music emerged, for instance, the music industry first ignored this growing digital trend as their revenue was then at an all-time high.[24] Later on, instead of adapting to this new technology, the music industry attempted to sue it out of existence, and this strategy even included suing end-users. As 3D printing now moves into complex and investment-intensive parts of the manufacturing industry, it appears probable that the incumbents will heavily rely on

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[18] 3D Printing has already been likened to highly disruptive technologies such as digital books and music, which have drastically changed the consumer landscape. DR Desai and GN Magliocca 'Patents, meet Napster: 3D Printing and the Digitization of Things' (2014) 102 Geo L J 1691. In 2012, the Pirate Bay announced the 'next step' for the sharing society: the 'physibles' 3D-printing category consisting of digital files representing physical objects. See K Scott, 'The Pirate Bay Adds "Physibles" 3D-printing Category' (*Wired,* 24 January 2012) <https://www.wired.co.uk/news/archive/2012-01/24/pirate-bay-introduces-physibles> accessed 30 November 2018. Mendis points out the parallels with online platforms such as Napster and the need to analyse the legal implication of 3D printing. D Mendis, "'The Clone Wars": Episode 1 - The Rise of 3D Printing and Its Implications for Intellectual Property Law - Learning Lessons from the Past?' (2013) 35(3) EIPR 155, 159.

[19] See, for instance, NA Syzdek, 'Five Stages of Patent Grief to Achieve 3D Printing Acceptance' (2015) 49(2) USF L Rev 335.

[20] J Dumortier and others, 'Legal Review on Industrial Design Protection in Europe (MARKTD2014/083/D, 2016) <https://ec.europa.eu/docsroom/documents/18921/attachments/1/translations/en/renditions/native> accessed 30 November 2018.

[21] LS Osborn 'Regulation Three-dimensional printing: The Converging Worlds of Bits and Atoms' (2014) 51 San Diego L Rev 553, 620; P Reddy, 'The Legal Dimension of 3D printing: Analyzing Secondary Liability in Additive Layer Manufacturing' (2014) 16 Columbia Science and Technology Law Review 222, 246–47.

[22] IBM Institute for Business Value, 'The New Software-defined Supply Chain Preparing for the Disruptive Transformation of Electronics Design and Manufacturing' (2013), 12 <http://public.dhe.ibm.com/common/ssi/ecm/gb/en/gbe03571usen/GBE03571USEN.pdf> accessed 30 November 2018. Emphasis added.

[23] L Lessig, *Free Culture: How Big Media Uses Technology and the Law to Lock Down Culture and Control Creativity* (Penguin 2004).

[24] See B Owsinski, 'How the Music Industry Created Its Own Worst Nightmares' (*Forbes* 7 August 2014) <https://www.forbes.com/sites/bobbyowsinski/2014/08/07/how-the-music-industry-created-its-own-worst-nightmares> accessed 30 November 2018.

intellectual property protection and enforcement to protect their business and prevent competition.[25] In a largely decentralised 3D printing context, intellectual property enforcement is likely to target the distribution of protected designs by intermediaries.

Notably, the current consumer 3D printing market is largely characterised by openness and collaboration, and many 3D printable designs are made available for-free and under 'open licences'. [26] While the current ecosystem provides opportunities for established businesses to adapt to, or develop a business strategy that addresses the growing 3D printing market, the risk remains that their reaction to 3D printing could hinder its use and development. In addition, 3D printing technology has also developed within the industrial market which, in contrast to the consumer market, relies heavily on intellectual property protection.[27] The World Intellectual Property Organisation (WIPO) has indicated that the fading distinction between the two markets is leading to rising tensions between the 'open' consumer market and the 'closed' industrial market:[28]

> This tension is pronounced when business strategies for the two market segments intersect, particularly when the industrial players enter the personal market space and the issue arises of open versus closed appropriability regimes.[29]

The technology's potential for transformation is clear. With the intellectual property implications increasingly at the forefront, it is important to examine how this disruptive technology interacts with legal frameworks whose ultimate aim is to promote creativity and innovation.

The challenges to the current intellectual property system have been recognised; however, in absence of immediate intellectual property concerns has

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[25] The aggressive way in which the industry has already been attacking 3D printing, particularly 3D models, has been compared to 'su[ing] the genie back into the bottle'. See S Henn, 'As 3-D printing Becomes More Accessible, Copyright Questions Arise' (*NPR*, 9 February 2013) <https://www.npr.org/sections/alltechconsidered/2013/02/19/171912826/as-3-d-printing-become-more-accessible-copyright-questions-arise> accessed 30 November 2018.
[26] See 1.2.1 – The 3D Printing Market Dichotomy.
[27] See 4.3.1 – Proprietary Hardware and Processes.
[28] WIPO, 'World Intellectual Property Report: Breakthrough Innovation and Economic Growth' (2015), 106 <https://www.wipo.int/edocs/pubdocs/en/wipo_pub_944_2015.pdf> accessed 30 November 2018.
[29] ibid.

caused governments to adopt a 'wait and see' attitude.[30] Similarly, scholars have argued that considering the current status of consumer 3D printing

> a premature call for legislative and judicial action in the realm of 3D printing could stifle the public interest' of "fostering creativity and innovation and the right of manufacturers and content creators to protect their livelihoods".[31]

While recognising that, at least for most industries, sectors and products, there is no direct risk by consumer 3D printing for rights holders right now, it is submitted that the current intellectual property rights frameworks and their utilisation create sub-optimal conditions for enabling widespread adoption and use consumer 3D printing. Promoting consumer 3D printing is caught in the paradoxical situation where the lack of access to digital models limits mass adoption which, in turn, diminishes incentives to make digital models available. A peer production model of creation currently drives consumer 3D printing and makes digital models available to consumers, generally for free. Companies, on the other hand, have been largely reluctant to making designs available for the consumer market, and the availability of digital models, both authorised and unauthorised, poses a threat to those who rely on intellectual property protection. Attempts to restrict the dissemination of digital models through legal means could, however, have detrimental, effects on the creation of digital models, and thus impair the advancement of consumer 3D printing generally. Such result would conflict, it appears, with the ultimate aim of intellectual property protection to facilitate creativity and innovation.

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[30] For instance, in its 2015 report on the law of registered designs, the Australian Advisory Council on Intellectual Property (ACIP) recommended 'no change to the design system at this time to respond to 3D printing and scanning technologies'. Advisory Council on Intellectual Property, *Review of the Designs System*, Final Report (March 2015) 41, recommendation 21 <https://www.ipaustralia.gov.au/sites/g/files/net856/f/acip_designs_final_report.pdf> accessed 30 November 2018. The Australian Government agreed that in absence of evidence it would be premature to take legislative action; however, it said to 'continue to monitor technological developments and their implications for the designs system'. Australian Government, *Government Reponse - ACIP Report Review of the Designs System* (6 August 2016) 8–9 <https://www.ipaustralia.gov.au/sites/g/files/net856/f/government_response_-_acip_designs_review_-_final_pdf.pdf> accessed 30 November 2018. In 2016, the Australian Productivity Commission supported the positions that no changes be made to Design system at the time. Australian Government Productivity Commission, 'Intellectual Property Arrangements', Productivity Commission Inquiry Report No. 78 (23 September 2016), 345 <https://www.pc.gov.au/inquiries/completed/intellectual-property/report/intellectual-property.pdf> accessed 30 November 2018.

[31] Mendis and Secchi (n 82) 43, quoting M Susson, 'Watch the World "Burn": Copyright, Micropatent and the Emergence of 3D Printing' unpublished paper (2013), 39 <http://works.bepress.com/matthew_susson/3> accessed 30 November 2018.

Objectives and Scope of the Study

This thesis examines the intellectual property implications of the global phenomenon of *consumer* 3D printing. It seeks to answer the research question: How can the intellectual property framework be used and optimised to promote consumer 3D printing? The aim is twofold. In seeking to answer the primary research question, this work, first and foremost, wants to analyse and better understand the interrelation between intellectual property and consumer 3D printing. Thus far, research has been largely siloed and a comprehensive analysis of the relationship between the various intellectual property regimes remains missing. In addition, many issues remain unclear and underexplored. This is particularly the case in regard to the consumer 3D printing. Secondly, it wants to contextualise the issues within South African law. There is a dearth of literature on this topic in South Africa, and most of the available research originates from the Global North. As a pioneering work in this area it aims to provide a better understanding of the South African intellectual property laws in the light of 3D printing-based decentralised creation and manufacturing. This is particularly relevant considering South Africa's various impending and ongoing intellectual property revisions processes.

Answering the overarching research question will require a critical consideration of the following subsidiary questions:

- How do consumer 3D printing and intellectual property rights interrelate?
- To what extent is the current legal framework in South Africa fit for purpose in the context of 3D printing, and if legislative change is required, what would this entail?
- How can the conflicts between open and closed appropriability regimes be reconciled?
- What strategies should the government and private sector employ to properly respond to consumer 3D printing technology?

This study is subject to limitations. First and foremost, the development of arguments in this thesis is grounded in technological and social premises, determined by the characteristics of the consumer 3D printing ecosystem and the additive manufacturing process, including design creation, dissemination and production. It is not grounded in the theoretical justifications for the endowment of intellectual property rights.

Second, this thesis approaches 3D printing from the perspective of intellectual property law only, particularly the law of trade marks, copyright, patents and designs. The impact of the technology on other fields of law,[32] including product liability,[33] gun control,[34] environmental law, consumer protection and contract law, is not addressed.

Third, the work's emphasis is on the consumer 3D printing market. More specifically, the research focusses on issues relating to the creation, customisation, dissemination and materialisation of digital models aimed at the consumer market. It does not investigate issues related to prototyping and industrial and experimental applications.

Finally, this work recognises that cross-border dissemination of digital models raises questions regarding applicable law, jurisdiction and enforcement.[35] However, these issues are not new and addressed elsewhere,[36] and a full analysis of issues of territoriality is beyond the scope of this thesis.

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[32] See B van den Berg, S van der Hof and E Kosta (eds), *3D Printing. Legal, Philosophical and Economic Dimensions* (Springer 2016).

[33] See NF Engstrom, '3-D Printing and Product Liability: Identifying the Obstacles' (2013) 162 University of Pennsylvania Law Review Online 35.

[34] See P Jensen-Haxel, '3D Printers, Obsolete Firearm Supply Controls, and the Right to Build Self-Defence Weapons under Heller (2012) 42 Golden Gate University Law Review 447; JJ Johnson, 'Print, Lock, and Load: 3-D Printers, Creation of Guns, and the Potential Threat to Fourth Amendment rights' (2013) 13 University of Illinois Journal of Law, Technology & Policy 337; RK Little, 'Guns Don't Kill People, 3D Printing Does? Why the Technology is a Distraction from Effective Gun Controls' (2014) 65 Hastings LJ 1505; CR McCutcheon, 'Deeper than a Paper Cut: Is It Possible to Regulate Three-dimensionally Printed Weapons or Will Federal Gun Laws be Obsolete Before the Ink Has Dried?' (2014) 14 University of Illinois Journal of Law, Technology & Policy 219: KF McMullen, 'Worlds Collide When 3D Printers Reach the Public: Modelling a Digital Gun Control Law After the Digital Millennium Copyright Act' (2014) Michigan State Law Review 187.

[35] H Wollgast, 'IP Infringements on the Internet – Some Legal Considerations' 2007 (1) WIPO Magazine 12.

[36] See European Max Planck Group on Conflict of Laws in Intellectual Property, *Conflict of Laws in Intellectual Property: The CLIP Principles and Commentary* (OUP 2013); American Law Institute, *Intellectual Property: Principles Governing Jurisdiction, Choice of Law, and Judgments in Transnational Disputes* (American Law Institute 2008).

Methodology

This thesis mainly adopts a doctrinal methodology. It is undertaken by way of desktop, literature-based study. The enquiry into the effectiveness of the current legal framework demanded an adequate understanding of 3D printing technology and the social dynamics within the consumer 3D printing community. By incorporating interdisciplinary aspects, this work aimed to comprehensively contextualise the technology within the various intellectual property frameworks, as well as uncover and analyse new and under-examined issues. A comparative analysis is applied for examining and interpreting national and international laws.

Within this framework, the primary focus was on legislative sources and judicial decisions within the field of copyright, trade marks, designs, and patents, particularly in South Africa. This is crucial to understand the regulatory context in which the consumer 3D printing ecosystem operates, and allows for the contextualisation and delineation of various issues. Considering the similarities in legislation and the persuasive authority of English decisions, a comparative analysis was undertaken of the laws of the EU, and the UK in particular.[37] In this context, references are made to the supranational framework, including international conventions and regional instruments. Chapter Five of this thesis also relies on US law. The reasons for this choice are the maturity, leading role and international influence of US copyright law.

As legal issues around this topic only started to arise recently, no case law particularly relating to consumer 3D printing is available in the jurisdictions examined. However, case law concerning related disruptive technologies, including digital file sharing, is analysed and applied where appropriate. References to foreign case law dealing with 3D printing have been included.

Secondly, this works relies on academic literature, policy documents, newspaper reports and online sources. In South Africa there is a paucity of literature on the topic. As indicated below, there is a growing body of academic literature on the topic of intellectual property and 3D printing, and the growing influence of the

[37] See, for instance, *Beecham Group plc v Triomed (Pty) Ltd* 2003 (3) SA 639 (SCA) 645; *Verimark (Pty) Ltd v BMW AG* 2007 (6) SA 263 (SCA) 268, 270; *Bayerische Motoren Werke Aktiengesellschaft v Grandmark International (Pty) Ltd and Another* 2014 (1) SA 323 (SCA), [9]; *Swisstool Manufacturing Co. v Omega Africa Plastics* 1975 (4) SA 379 (W) 382.

technology has, to some extent, led to empirical research and policy documents. In addition, this thesis also relies on literature relating to technological and social elements of the 3D printing process in order to contextualise the technology within the various intellectual property frameworks.

Literature Review

This thesis meets its objectives through desktop study that relies on numerous sources of law, including legislation and case law from South Africa, the UK and EU, and secondary sources such as books, journal articles, publishes theses, official documents and reports, and newspaper articles.

In South Africa, there is no case law specifically dealing with intellectual property and (consumer) 3D printing. This is equally the case for the UK and EU. In the US, however, there are various cases that deal 3D printing. These cases mainly concern disputes relating to 3D printing patents in the industrial market segment and have limited relevance to this work. Occasional references are made throughout this thesis where applicable. In addition, there is a dearth of case law in South Africa on certain legal concepts and the various intellectual property issues generally relating 3D printing.

There is also a paucity of secondary sources available on South African law. Those that are available include short commentaries and published student LLM theses. None of these contributions offer a complete and in-depth analysis of the subject.

On the international level there is an abundance of literature on the topic of intellectual property and 3D printing. Amongst the scholars that have focused their research to this topic are Rosa Ballardini, Teshager Dagne, Angela Daly, Ben Depoorter, Deven Desai, Timothy Holbrook, Mark Lemley, Marcus Norrgård, Gerard Magliocca, Thomas Margoni, Dinusha Mendis, Lucas Osborn, Jouni Partanen, and Matthew Rimmer. Volumes such as *3D Printing Intellectual Property and Innovation – Insights from Law and Technology* edited by Rosa Ballardini, Marcus Norrgård and Jouni Partanen, *3D Printing and Beyond: Intellectual Property and Regulation*

(forthcoming) edited by Dinusha Mendis, Mark Lemley and Matthew Rimmer, and *3D Printing and Intellectual Property* (forthcoming) by Lucas Osborn, demonstrate the current relevance of the intellectual property issues raised by 3D printing.

However, the existing body of literature has been largely fragmented across the various areas of intellectual property, and the primary focus has been on copyright and patents. The literature on other areas of intellectual property is less developed and no comprehensive analysis of their relationship has been provided. Subsequently, various issues remain unclear and underexplored. This is particularly the case for the consumer segment of the 3D printing market, which is the focus of this thesis.

Chapter Outline

This thesis is divided into seven chapters, excluding this introduction.

The first chapter broadly describes the phenomenon of 3D printing. It explains the mechanics and ecosystem behind consumer 3D printing, including the technical and collaborative aspects of the generic 3D printing process, the dynamics within the consumer market, and the various design dissemination methods.

Chapters Two to Five contextualise 3D printing within the laws of trade marks, designs, patents and copyright, respectively. These chapters follow the same structure: they begin by explaining, in general terms, the forms of intellectual property under discussion, and this is followed by an in-depth examination of the impact of 3D printing-based digitisation as well as decentralised manufacturing on the various elements of the respective type of protection. Each of these chapters concludes by summarising the main overarching legal issues for the intellectual property regime in question.

Chapter Six then analyses the means available to rights holders to retain control over their intellectual property rights in an era of increased digitisation. In particular, it shows how these measures may affect the creative and operational dynamics within the consumer 3D printing community, ultimately determining the efficacy of consumer 3D printing. With this in mind, the chapter goes on to analyse potential approaches for rights holders to respond to the emerging technology, in

particular approaches towards design dissemination, co-creation and peer production, and intellectual property infringement. This chapter concludes with an examination of the complex dynamic between various right holder-based approaches.

The seventh and final chapter concludes this thesis, and provides proposals for a legal response to 3D printing in as far as intellectual property law and policy is concerned.

This thesis is based on the law and materials available as of December 2018.

Chapter One
3D Printing: Technology, Ecosystem and Collaborative Dynamics

'The power of 3D printing lies in tapping into local needs and inspiring creativity'[38]

1.1 – Introduction and Terminology

This chapter provides an overview of the 3D printing phenomenon.[39] More specifically, it provides a description of the—in legal literature often oversimplified—technical and social aspects that underpin the technical 3D printing process, from the creation of digital models to various 3D printing techniques.[40] A thorough understanding of this process and the relevant terminology is imperative to accurately contextualise 3D printing within the different intellectual property regimes, as discussed in the following chapters. This chapter focusses on the consumer 3D printing ecosystem, its actors, and the emerging secondary collaborative user-based economy. It completes its survey of the 3D printing ecosystem by discussing the various dissemination methods that can be applied to making products available for 3D printing, and consumer 3D printing in particular.

[38] The late Professor Calestous Juma. C Juma, 'The 3D Printing Revolution' (*New African Magazine,* 6 March 2015) <http://newafricanmagazine.com/3d-printing-revolution> accessed 30 November 2018.
[39] This work considers 3D printing in the broad sense: a process that includes digital modelling, characterised by collaborative dynamics and mass dissemination of digital models, and the subsequent materialisation thereof through additive manufacturing processes. See 1.1.1 – Defining '3D Printing'.
[40] Legal literature typically neglects various steps within the technical and creative 3D printing process. Examples include the distiction between digital models (CAD models) and the design files that embed them (CAD files), post-processing of the design file, and the various designs dissemination methods. These elements are imperative and fulfil a central role in determining the application and scope of intellectual protection.

1.1.1 – Defining '3D Printing'

In the strict sense,[41] 3D printing is the collective term for a set of general-purpose additive manufacturing processes that physically build up three-dimensional objects from a computer-aided design (CAD) model (hereinafter also referred to as 'digital model').[42] These technologies have existed for several decades; however, it was not until around 1990 before they really gained momentum.[43] These processes differ drastically from most conventional manufacturing processes as the final product is built up by adding, rather than subtracting material—generally in a layer-by-layer fashion. For example, the most well-known form of additive manufacturing process consists of the material extrusion process which extrudes material through a small diameter nozzle at high temperatures, hereafter allowing the layers to cool and bond together.[44] 3D printing offers a number of structural benefits such as the ability to produce complex shapes that would otherwise be difficult or impossible to build using traditional methods and the facilitation and expedition of the prototyping process.[45] In fact, while 3D printing was originally solely used for 'rapid prototyping',[46] it is now playing an increasing role in component and end-product manufacturing.[47]

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[41] Other commentators apply different 3D printing terminology. For instance, Bechtold refers to 3D printing in a narrow sense as a basic extension of normal inkjet printing, while considering 3D printing in the broader sense as the set of currently available 3D printing technologies. S Bechtold, '3D Printing and the Intellectual Property System' WIPO Economic Research Working Paper No. 28 (2015), 4 <https://www.wipo.int/edocs/pubdocs/en/wipo_pub_econstat_wp_28.pdf> accessed 30 November 2018.

[42] Embedded in a CAD file. The technical aspects of the 3D printing process are discussed in detail in 1.3 – The Technical Aspects of the Generic 3D Printing Process.

[43] Early research and development of technology to create solid objects using photopolymers using a laser took place in 1960s and involved a dual laser beam approach. See, for example, WK Swainson, 'Method, medium and apparatus for producing three-dimensional figure product' (1977) US patent 4041476. In 1980, Hideo Kodama invented the first single-beam laser curing approach, which is similar to the current predominant 3D printing technology. For a brief historical overview see S Bechtold, '3D Printing, Intellectual Property and Innovation Policy' (2016) 47(5) ICC 517, 520–21.

[44] The different printing processes are discussed below. See 1.3.3 – Printing: Typology of 3D Printing Technologies.

[45] For an overview of the benefits of 3D printing see G Banning, '3D Printing: New Economic Paradigms and Strategic Shifts' (2014) 5(1) Global Policy 70, 71–72.

[46] R Bogue '3D printing: The Dawn of a New Era in Manufacturing?' (2013) 33(4) Assembly Automation 307.

[47] It is predicted that 50% of the 3D printed output will consists of final products. Wohlers Associates (n 13). See also L Bechtold and others, '3D Printing: A Qualitative Assessment of Application, Recent Trends and the Technology's Future Potential' Study 17-2015 (2015), 15–17 <https://www.e-fi.de/fileadmin/Innovationsstudien_2015/StuDIS_17_2015.pdf> accessed 30 November 2018.

According to one commentator:

> 3D printing is the 'last piece of the puzzle' that enables consumers to intervene at any stage in the production process, from the initial idea to the fully manufactured product, and even to carry out most (if not all) of this process.[48]

In the broader sense, 3D printing covers the process that includes digital modelling, characterised by customisation, peer production, co-creation and mass dissemination, and the subsequent production thereof through AM processes.[49] Rather than producing goods centrally and distributing them around the world, the technology facilitates decentralised manufacturing and uses network technologies to easily distribute digital designs. Despite the focus on decentralised production, a number of 3D printing-based business models utilise decentralised design but make use of centralised production facilities.[50]

1.2 – The Consumer 3D Printing Market

1.2.1 – The 3D Printing Market Dichotomy

In recent years, 3D printing has developed into two distinctive markets:[51] the industrial or production market, and the consumer or personal market.[52] These markets are characterised by different approaches to knowledge appropriation, costs, level of technology and future development.[53]

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[48] T Rayna, L Striukova and J Darlington, 'Co-creation and User Innovation: The Role of Online 3D Printing Platforms' (2015) 37 Journal of Engineering and Technology Management 90, 91.
[49] The various elements that preceed the actual manufacturing process are discussed later in this thesis. 1.3 – The Technical Aspects of the Generic 3D Printing Process; 1.4 – The Collaborative Aspects of the Creative Process; 1.5 – Design Dissemination Methods.
[50] Hereby assuring quality production, access to advanced technologies and materials, and assistance. See 1.5.2 – Physical Distribution.
[51] For purposes of this work, research applications are discussed under industrial/production market. On the industrial/production market see P Reeves and D Mendis, 'The Current Status and Impact of 3D Printing Within the Industrial Sector: An Analysis of Six Case Studies' 2015/41 (2015) <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/549046/Study-2.pdf> accessed 30 November 2018; J Bertling and S Rommel, 'A Critical View of 3D Printing Regarding Industrial Mass Customization Versus Individual Desktop Fabrication' in Jan-Peter Ferdinand, Ulrich Petschow and Sascha Dicket (eds), *The Decentralised and Networked Future of Value Creation* (Springer 2016) 75.
[52] Considering the scope and limitations of this work, a comprehensive discussion of the industrial segment of the market is not provided.
[53] See WIPO (n 28).

Within the industrial or production market, the technology has developed into a key end-product manufacturing process for the production of advanced, customised, small-batch products. The market consists of medical, including orthopaedic implants and bio-printing,[54] automotive, aerospace[55], and many universities,[56] companies[57] and governments[58] are heavily investing in 3D printing technology. The advantages offered by AM include rapid prototyping, the production of customised and 'one-off' goods, and more efficient material use. Compared to personal desktop 3D printers , advanced industrial 3D printers are less limited by shape, size and materials;[59] however, they are still facing various technical challenges. Most profoundly, the cost of industrial printers and raw materials is still high and does often not compare favourably to traditional manufacturing procedures.[60]

Parallel to the industrial market, a second distinct market targeted towards consumers has developed. This consumer segment is still a niche market that largely consists of hobbyists, tinkerers and geeks. It comprises many advocates for collaborative innovation and open appropriability regimes, such as open source licensing.[61] According to WIPO:

> The personal 3D printing ecosystem was built around the open sharing philosophy, while its industrial counterparts relied — and continue to rely — on proprietary knowledge and technologies to advance innovation.[62]

Open source licensing allows the source of work (source code, blueprint or digital design) to be used, modified and shared under the conditions spelt out in the

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[54] Bioprinting is the use of computer-controlled printing (esp. 3D printing) with living cells or other biological materials (e.g. to produce tissue for reconstructive surgery). 'bioprinting, n' (*OED Online*, OUP June 2013) <http://www.oed.com/view/Entry/19188> accessed 30 November 2018.
[55] J Paur, 'NASA Fires Up Rocket Engine Made of 3-D Printed Parts' (*Wired,* 28 August 2013) <https://www.wired.com/2013/08/nasa-3d-printed-rocket-engine/ > accessed 30 November 2018.
[56] S Phillips, '13 Universities Heavily Investing in 3D printing' (*Inside 3DP,* 16 June 2014) <https://www.inside3dp.com/13-universities-investing-heavily-3d-printing> accessed 9 October 2018.
[57] See, for example, R D'Aveni 'The 3-D Printing Revolution' (May 2015) Harv Bus Rev 40, 47.
[58] For instance, on 22 October 2012 the United Kingdom's Universities and Science Minister David Willetts announced that the government will invest £7 million for research and development in additive manufacturing. S Harris, '£7m Funding for UK Additive Manufacturing Projects' (*The Engineer,* 23 October 2013) <https://www.theengineer.co.uk/issues/october-2012-online/7m-funding-for-uk-additive-manufacturing-projects> accessed 30 November 2018.
[59] Materials include plastics, resins, super alloys, stainless steel, glass, titanium, polymers and ceramics.
[60] Most scholars agree that 3D printing will not replace traditional manufacturing methods, but can be used to enhance various processes.
[61] B Rideout, 'Printing the Impossible Triangle: The Copyright Implications of Three-dimensional Printing' (2011) 5 Pepperdine Journal of Business, Entrepreneurship & the Law 161, 164–65.
[62] WIPO (n 28).

licence. Many digital models,[63] printer part designs,[64] design programs,[65] slicer programs,[66] and guides are licensed open source and available for free. As will be discussed in more detail later, open source 3D printers, such as the RepRap, have paved the way for affordable and accessible consumer 3D printing.[67] The open source licensing of digital models has equally contributed to the development of the consumer 3D printing, particularly the 3D printing design creative process.[68]

1.2.2 – Actors

The consumer 3D printing ecosystem comprises diverse actors that are involved at different stages of the manufacturing process. In many instances, these actors operate in interrelated, conflicting, and potentially overlapping capacities.[69] This, it is submitted, calls for a nuanced approach not only regarding the level of innovation, but the extent of infringement, and the consequences of enforcement. The liabilities of each of these actors within the law of trade marks, copyright, patents and designs, are discussed in the next chapters.

For purposes of this work, the most relevant actors are categorised as follows:

- Consumers who download, create, adapt, disseminate and materialise digital models;[70]
- Rights holders who want to exercise their rights;

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[63] Thingiverse, for instance, provides the option license designs under one of the Creative Commons (CC) licences where before February 2012 the only option was the reserve all rights of place the design in the public domain. See Bre Pettis 'Thingiverse Updates Terms of Use and License Options' (*Thingiverse blog,* 10 February 2012) <http://blog.thingiverse.com/2012/02/10/thingiverse-updates-terms-of-use-and-license-options/> accessed 30 November 2018. All CC licenses allow for non-commercial copying under the conditions of attribution. Many of the licenses also allow for modification of the designs. See <https://www.thingiverse.com/legal> accessed 30 November 2018; <http://creativecommons.org/licenses> accessed 30 November 2018.

[64] The most well-known open source DIY printers is RepRap. The RepRap printer is licensed under the GNU General Public License. <http://reprap.org/wiki/RepRapGPLLicence> accessed 30 November 2018. Notably, the RepRap is able to replicate the parts it is made off thus replicate itself. See R Jones and others, 'RepRap – The Replicating Rapid Prototyper' (2011) 29 Robotica 177

[65] Such as Sketchup <https://www.sketchup.com>, and Blender <https://www.blender.org>. In addition, 3D design is made more accessible through the availability of easy design apps, which enable almost anyone to create and customise 3D objects.

[66] For example, the slicing software 'Slic3r' is licensed under the GNU Afferno General Public License, version 3. <https://www.slic3r.org> accessed 30 November 2018. See also 6.3.2.2 – GNU.

[67] 4.3.2 – Open Source Initiatives.

[68] 1.4 – The Collaborative Aspects of the Creative Process.

[69] Users of digital models often become creators of derivative designs. *Cf.* 1.2.2.1 – Consumers and 1.2.2.2 – Intellectual Property Rights Holders. See also 1.2.2.3 – Design Sharing Platforms.

[70] Or, in some instances, 3D printed objects.

- Design sharing platforms, including the often overlapping category of printing service providers;[71]
- Peer-to-Peer file sharing services; and
- 3D printing technology providers, including hardware and software producers.

Each category is discussed in more detail below.

1.2.2.1 – Consumers – The consumer typology is characterised by divergent levels of use, creativity and innovation. In the 3D printing ecosystem, many consumers (hereinafter also referred to as 'users') can be referred to as 'user-innovators'.[72] Sophisticated users are able to create their own design or make modifications to existing designs, effectively blurring the boundaries between innovator/creators and consumers. This phenomenon of user-centred innovation and creativity is discussed in detail later.[73] It must, however, be noted that many consumers lack the technical skills and knowledge required to create their own digital models, and their use of 3D printer is highly dependent upon access to easy-to-use digital models, software and hardware. This demand is primarily fulfilled by design sharing platforms that provide digital designs and access to advanced, yet centralised, on-demand 3D printing services.[74]

From an intellectual property perspective, the actions of consumers are of particular interest. During the different stages of the 3D printing process, consumers often engage in potentially infringing activities, making the question whether these actions are indeed permitted or not pertinent. The role of users goes beyond mere 'use', *i.e.* downloading and materialising the digital model; and includes activities from the creation of new designs, to modifications, customisations and the dissemination thereof. In turn, user behaviour will in many instances lead to the creation of works that are eligible for intellectual property protection.

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[71] The dissemination model dictates what type of good is dissemination via the platform; therefore, this work uses the term 'design sharing platforms' rather than 'file sharing platforms'.
[72] Bechtold (n 41) 12. Others refer to this type of consumer as 'prosumers'.
[73] In 1.4 – The Collaborative Aspects of the Creative Process.
[74] And in a lesser extent by P2P file sharing services. See 1.2.2.3 – Design Sharing Platforms; 1.2.2.4 – Peer-to-Peer File Sharing Services.

1.2.2.2 – Intellectual Property Rights Holders – Intellectual property rights holders have the exclusive rights to do or to authorise certain acts in relation to the protected subject matter.[75] However, they do not necessarily play an antagonist role in the context of consumer 3D printing, and as will become apparent later, many '*user*-innovators' will be owners of the intellectual property. Conversely, in the situation where intellectual property owners are not user-innovators, they do in principle not play an active role in the 3D printing process; however, they become active participants, unwillingly, when their intellectual property is (at the risk of) being infringed or consumers demand their goods to be made accessible for 3D printing.

1.2.2.3 – Design Sharing Platforms – Various intermediaries provide users with Internet access and related services, including Internet service providers (ISPs) and online service providers (OSPs). ISPs provide users with access to the Internet and generally act as mere conduit of information. They have the technical ability to restrict internet access, and therefore infringement; however, this work will primary focus on OSPs.

OSPs are websites and Web 2.0 applications which can potentially host, store or link to protected materials.[76] These providers include content-sharing websites, web hosting sites and online auctions, and are most likely to be at the forefront of the legal consequences of 3D printing technology. They occupy a key position within the 3D printing ecosystem for the creation and use of creative content by facilitating distributed manufacturing and eliminating many barriers facing consumer 3D printing.[77] Importantly, they may be exempted from liability under so-called 'safe

[75] See Chapters 2–5.
[76] Web 2.0 refers to the participatory or social web. It entails websites that focus on user-generated content, usability, participation and interoperability for its users. The term gained popularity in 2004 after the Media Web conference. A Matthew, 'Tim O'Reilly and Web 2.0: The Economics of Memetic Liberty and Control' (2009) 42(2) Communication, Politics and Culture 6.
[77] Their role in controlling copyright infringement has been recognised. OECD, *The Role of Internet Intermediaries in Advancing Public Policy Objectives* (OECD Publishing 2011). See also Directive 2001/29/EC of the European Parliament and of the Council of 22 May 2001 on the Harmonisation of Certain Aspects of Copyright and Related Rights in the Information Society (InfosSoc Directive), recital 59 in the preamble.

harbour' provisions,[78] and as a result their role increasingly involves assisting rights holders combatting unauthorised distribution.

This work consciously uses the term 'design sharing platforms' rather than 'file sharing platforms' for the reason that the scope of OSPs within the consumer 3D printing ecosystem is limited to the dissemination of designs both in digital and physical form rather than files in general, including photos, music and movies.[79] Design sharing platforms operate with different approaches to design dissemination, openness, and target audience.[80] Depending on their approach, different types of platforms raise different legal problems and issues in relation to intellectual property protection. While a significant number of platforms is dedicated to offering digital models for the professional engineering community, the majority of platforms target hobbyists, designers and consumers. In fact, many of these platforms have significantly contributed to the emergence of the 3D printing community of hobbyists, designers and consumers. Typically, these platforms only host original designs; however, it cannot be ruled out, of course, that some of the files hosted on these platforms are after all copies of third-party designs that are subject to copyright, industrial design, patent or trade mark protection. Yet another type of platform acts as a for-profit marketplace for designs and provides on-demand printing services. The various methods of design dissemination are discussed in detail later.[81]

Currently, the most important design sharing platforms are as follows:[82]

1.2.2.3.1 – Thingiverse – Thingiverse is generally referred to as the most influential 3D printing platform.[83] It emphasises the sharing of innovation and community collaboration. Users of the platform can upload and collaborate on designs, which are

[78] See 5.3.5 – Safe Harbours.
[79] See also 1.5 – Design Dissemination Methods.
[80] For the diversity of the 3D printing platforms landscape see Rayna, Striukova and Darlington (n 48); J Moilanen and others, 'Cultures of Sharing in 3D Printing: What Can We Learn from the License Choices of Thingiverse Users?' (2015) 6 Journal of Peer Production, Disruption and the Law.
[81] 1.5 – Design Dissemination Methods.
[82] The platforms are selected as they reflect the highest number of designs per platform. See D Mendis and D Secchi, 'A Legal and Empirical Study of 3D Printing Online Platforms and an Analysis of User Behaviour' UK IPO Research Paper 2015/41 (2015) <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/549045/Study-I.pdf > accessed 30 November 2018. Considering the aim of this illustrative list is to provide an overview of the different models of platforms, it further analyses The Pirate Bay, the first and only bittorrent tracker that has introduced a category for digital models.
[83] <https://www.thingiverse.com> accessed 30 Novemer 2018.

made available to others under an open licence, more specifically under a Creative Commons licence.[84] Other users can freely use and modify the designs as stipulated in the respective licence. Thingiverse also functions as a platform for users to share expertise on 3D printing and offers apps to, amongst other things, design and modify 3D objects[85] with the option to print the design at a local hub.[86]

The platform is characterised by an overlap with 3D technology providers. The free nature of Thingiverse is due to the platform being owned by MakerBot,[87] the most well-known producer of consumer 3D printers. The platform is ancillary to MakerBot's main line of business, *i.e.* the sale of 3D printing hardware, and the key value of the platform, from a user's perspective, lies in its offering of free and easily accessible designs for home 3D printing.[88]

1.2.2.3.2 – GrabCad – GrabCad[89] initially started as a platform to connect engineers with CAD-related jobs. The platform later evolved into a community for engineers to share CAD models and the platform currently offers more than 1.5 million free designs.[90] The focus of GrabCad is on its 'Workbench' application which allows users to view, edit, upload, download and manage models. While the platform is not primarily aimed at 3D printing, it hosts many designs that can be used for 3D printing.

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[84] Thingiverse made open source licensing mandatory in 2012. Users can choose between various licensing options. See also 6.3.2 – Open Source Licensing Schemes.
[85] <https://www.thingiverse.com/apps>. J Broer, '3D Design Made Easy: 3D Slash App Launches on Thingiverse' (*Makerbot Blog*, 23 May 2016) <https://www.makerbot.com/blog/2016/05/23/3d-design-made-easy-3d-slash-app-launches-thingiverse#more-77975> accessed 30 November 2018.
[86] See <https://www.thingiverse.com>. Thingiverse implemented apps that allow users without a 3D printer to send designs to a local hub which will print and deliver the designs. J Broer, 'First Thing Apps Now Available on Thingiverse' (*Makerbot Blog*, 18 April 2016) <https://www.makerbot.com/blog/2016/04/28/first-thing-apps-now-available-thingiverse#more-77773> accessed 30 November 2018.
[87] In 2013, Makerbot was bought by Stratasys, one of the major manufacturers of 3D printers and 3D production systems.
[88] Moilanen and other (n 80).
[89] <https://grabcad.com> accessed 30 November 2018. In 2014, 3D printing giant Stratasys acquired GrabCad for approximately 100 million USD. I Lunden, '3D Printing Company Stratasys Is Buying GrabCAD For Around $100M, Beating Out Autodesk, Adobe' (*TechCrunch*, 16 September 2014) <https://techcrunch.com/2014/09/16/3d-printing-company-stratasys-is-buying-grabcad-for-around-100m/> accessed 30 November 2018.
[90] <https://grabcad.com> accessed 30 November 2018.

1.2.2.3.3 – Shapeways – Shapeways[91] acts as a 3D model marketplace and printing service.[92] It allows its users to sell physical versions of their digital models to third parties while the company handles the billing, production and shipping. The platform does not sell the design files, but merely the physically printed good thereof. Consumers have access over 50 different materials and finishes, using various advanced 3D printing techniques. In addition to its marketplace and printing service function, the platform offers online tools for the creation of digital models.

1.2.2.4 – Peer-to-Peer File Sharing Services – Peer-to-Peer (P2P) file sharing services facilitate the exchange of digital content stored on the computers of the respective users—so-called 'peers'—amongst all the users of the network.[93] Users generally participate in the network using dedicated software. When the software is active and the computer is connected to the Internet, users can share files with the other participants, while maintaining a copy of the file.[94] Unlike the design sharing platforms that rely on the centralised hosting of files, P2P file sharing directly connects various peers without going through an intermediary server.

The 'generation' of the file sharing network determines, amongst other things, how peers locate files and how these files are shared across the network.[95] Currently, the most used incarnation of P2P file sharing is the BitTorrent protocol, which generally locates files through 'torrent' files or 'magnet links' that contain information to locate and exchange the file.[96] Users that want to download a file must open the respective file or link in the dedicated software, which then connects them to as many hosts as possible. The software breaks the source file(s) up into small-sized 'blocks', and the software reconstitutes the file as soon as all the blocks have

[91] <https//www.shapeways.com> accessed 30 November 2018.
[92] See, generally, E Strickland, 'Shapeways Bringing 3-D Printing to the Masses' (2013) 50(11) IEEE Spectrum 22.
[93] WMJ Fung and A Lakhani, 'Combatting Peer-to-Peer File Sharing of Copyright Material Via Anti-Piracy Laws: Issues, Trends, and Solutions' (2013) 29 Computer Law & Science Review 382, 383.
[94] ibid.
[95] R Steinmetz and K Wehlre (eds), *Peer-to-Peer Systems and Applications* (Springer 2005). This thesis focusses on the BitTorrent file sharing system; however, other and preceding classes of P2P file sharing systems must be mentioned, including centralised file-sharing and FastTrack.
[96] Torrent files hold information on the name and size of the file, the address of 'trackers' that maintain a list of information on the users that are hosting the file and where the file is located, and information on (re-)construction of the so-called 'blocks'. Magnet links have a similar function but do not require a 'tracker', nor does they require the user to download a file.

successfully been downloaded. These blocks can be received simultaneously from multiple hosts in a decentralised manner.

Online indexes enable users to locate specific torrent files and magnet links. Early 2012, The Pirate Bay, the world's biggest torrent index, introduced a 3D printing section to its website under the title 'Physibles'.[97] Many of these design files indexed by The Pirate Bay have been banned from other sharing websites due to policy or intellectual property infringement.[98] At present, however, the amount of 3D printing designs available on the platform is negligible.[99]

1.2.2.5 – 3D Printing Technology Providers – Providers of 3D printing hardware and software (hereinafter: 3D printing technology) are the key enablers for a decentralised manufacturing process. While hardware plays a key role in the actual materialisation of the design, software plays an integral role throughout the 3D printing process, including creating the computer-aided design, sharing designs over networks, 'slicing' and printing. The inception and emergence of consumer 3D printing hardware is closely linked to open source hardware development, in particular the RepRap project. The relevance of open source hardware initiatives is discussed later.[100]

1.2.2.6 – Other Actors – Various initiatives undoubtedly play an important role in enabling the creation of digital models and providing access to 3D printing hardware or on-demand printing services. The current ecosystem comprises of personal

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[97] J Bertolucci, 'Pirate Bay Launces 3D-printed "Physibles" Downloads' (*PCWorld,* 24 January 2012) <https://www.pcworld.com/article/248682/pirate_bay_launches_3d_printed_physibles_downloads.html> accessed 30 November 2018.

[98] Thingiverse banned the designs for guns as they are prohibit by their terms of service that state: 'You agree not to use the Site or Services to collect, upload, transmit, display, or distribute any User Content (i) that...physical harm of any kind against any group or individual, promotes illegal activities or contributes to the creation of weapons'. D Love, 'FINALLY SOME SENSE: A 3D Printing Heavyweight Decides It's Not Necessary to Make Guns At Home' (*BusinessInsider*, 19 December 2012) <https://www.businessinsider.com/thingiverse-removing-gun-files-2012-12) accessed 30 November 2018.

[99] At the time of writing the number of design files indexed by The Pirate Bay was less than 50.

[100] 4.3.2 – Open Source Initiatives.

printers, makerspaces, Fab Labs and 3D printing services.[101] Strategies to make 3D printing more available for consumers include localised distribution via 'FabStores' and others forms of close-to-market mini-factories.[102] In South Africa, a small number of companies is offering on-demand 3D printing and scanning services.[103] The scale of their production and the availability of advanced printing technologies appears to be rather limited compared to big international players, such as Shapeways[104] and Materialise.[105]

1.2.3 – The Status of Consumer 3D Printing

> [I]t is entirely plausible to envision a not-too-distant world in which most things that people want can be downloaded and created on site for very little money.[106]

3D printing could revolutionise consumption; however, much of the (initial) hype surrounding the technology was based on new applications and individual success stories, which often neglect to sufficiently differentiate between consumer, industrial and research applications. The conjoined impact of the decrease in price of extrusion 3D printers[107] and the rise of 3D file sharing platforms has nonetheless drastically lowered the bar for consumer 3D printing.[108] This said, the technology is still considered to be at an early stage of development for widespread consumer use and there has been a lot of scepticism and speculation about the capabilities of consumer-

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[101] Fab Labs and makerspaces compose two interesting examples of decentralised manufacturing facilities that stimulate local social and collaborative endeavours. P Troxler, 'Libraries of the Peer Production Era' in Bas van Abel and others (eds), *Open Design Now. Why Design Cannot Remain Exclusive* (BIS 2011), 86–95; C Anderson, *Makers: The New Industrial Revolution* (Crown 2012); AR Schrock, '"Education in Disguise": Culture of a Hacker and Maker Space' (2014) 10(1) InterActions: UCLA Journal of Education and Information Studies 1.

[102] C Ihl and F Piller '3D Printing as Driver of Localized Manufacturing: Expected Benefits from Producer and Consumer Perspectives' in Jan-Peter Ferdinand, Ulrich Petschow and Sascha Dicket (eds), *The Decentralised and Networked Future of Value Creation* (2016 Springer), 179.

[103] For instance, 3D forms and Berg 3D printing. <https://www.3Dforms.co.za> accessed 5 June 2019; <https://www.berg3Dprinting.co.za> accessed 5 June 2019.

[104] <https://www.shapeways.com> accessed 5 June 2019. See also 1.2.2.3.3 – Shapeways.

[105] <https://www.materialise.com> accessed 5 June 2019.

[106] Lemley (n 15) 462.

[107] See McKinsey Global Institute (n 11) 109.

[108] The reduction in hardware cost is largely attributed to the rise of open source hardware initiatives and the expiration of key 3D printing patents. See 4.3 – Patents and Accessibility to 3D Printing Technology.

grade 3D printers.[109] For example, back in 2010, Bradshaw, Bowyer and Haufe already concluded:

> [T]he most optimistic evangelist of low-cost 3D printing would probably admit that the household domestic 3D printer is years, if not decades, from widespread use. Its impact will be gradual, as unlike file-shared MP3s it will not immediately provide for the reproduction of faithful copies […] the IP implications of such further developments have so far been imagined only in science fiction.[110]

Indeed, empirical research indicates that activity on online design sharing platforms is not a mass phenomenon as yet and that fears concerning widespread consumer 3D printing are mostly pre-emptive.[111] However, over the last decade, the intellectual property implications have become more tangible. Many commentators point to the large number of unlicensed and potentially infringing design files online,[112] and increasingly, designers and hosting websites have received cease and desist letters, and take down notices.[113] However, to this date no court cases have been filed.[114]

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[109] See, for instance, M Burns and J Howison 'Digital Manufacturing – Napster Fabbing: Internet Delivery of Physical Products' (2001) 7 Rapid Prototyping Journal 194; JM Pearce and others '3-D Printing of Open Source Appropriate Technologies for Self-directed Sustainable Development' (2010) 3(4) Journal of Sustainable Development 17, 18; Finocchiaro (n 14) 489–90; A Daly, *Socio-Legal Aspects of the 3D Printing Revolution* (Palgrave Macmillan 2016), 99.

[110] S Bradshaw, A Bowyer and P Haufe, 'The Intellectual Property Implications of Low Cost 3D Printing' (2010) 7(1) SCRIPTed 5, 31.

[111] Mendis and Secchi (n 82).

[112] For example, K Stevenson, 'The Frequency of 3D Content Violations is Astonishing' (*Fabbaloo*, 20 August 2016) <https://www.fabbaloo.com/blog/2016/8/20/the-frequency-of-3d-content-violations-is-astoishing> accessed 30 November 2018. See also Mendis and Secchi (n 82) 41.

[113] Since 2011, both designers and hosting websites of 3D models received cease and desist letters and take down notices. See, in chronological order, M Masnick 'Is This the First DMCA Notice over 3D Printer Plans?' (*Techdirt,* 22 February 2011) <https://www.techdirt.com/articles/20110221/22375313196/is-this-first-dmca-notice-over-3d-printer-plans.shtml> accessed 30 November 2018; N Anderson, 'Paramount: No 3D Printing of Our Alien Super 8 Cubes!' (*Ars Technica,* 29 June 2011) <http://arstechnica.com/tech-policy/2011/06/paramount-no-3d-printing-of-our-alien-super-8-cubes/> accessed 30 November 2018; C Thompson, '3D Printing's Forthcoming Legal Morass' (*Wired,* 31 May 2012) <https://www.wired.co.uk/news/archive/2012-05/31/3d-printing-copyright> accessed 30 November 2018; N Hurst, 'HBO blocks 3-D Printed Game of Thrones iPhone Dock' (*Wired*, 13 February 2013) <https://www.wired.com/degisn/2013/02/got-hbo-cease-and-desist> accessed 30 November 2018; N Statt, 'Print Chop: How Copyright Killed a 3D-printed Final Fantasy Fad' (*CNET*, 16 August 2013) <https://www.cnet.com/news/print-chop-how-copyright-killed-a-3d-printed-final-fantasy-fad/> accessed 30 November 2018; A Bogle 'Good News: Replicas of 16th-century Sculptures are Not Off-limits for 3-D Printers' (*Slate*, 26 January 2015) <https://www.slate.com/bogs/future_tense/2015/01/26/_3_d_printing_and_copyright_replicas_of_16th_century_sculptures_are_not.html> accessed 30 November 2018; B Valentine, A Chess Set in Homage to Marcel Duchamp, with Mustaches' (*Hyperallergic*, 2 September 2015) <http://hyperallergic.com/233601/a-chess-set-in-homage-to-marcel-duchamp-with-mustaches/> accessed 30 November 2018; T Koslow, 'Disney Pulls Star Wars Models from Thingiverse: An Inside Look at Copyright Issues in the 3D Space' (*All3DP*, 12 November 2017) <https://all3dp.com/disney-pulls-star-wars-models-from-thingiverse/> accessed 30 November 2018.

The end-product capabilities of most consumer grade 3D printers currently pose significant limitations regarding complexity, dimensions, resolution and materials. Empirical evidence supports the theory that typical products fall within the leisure and hobby categories, including toys,[115] figurines, jewellery,[116] and chocolates.[117]

The potential for the production of spare parts is not altogether clear. There are indications of the impact of industrial 3D printing in this area;[118] however, according to a study commissioned by the UK IPO, the production of most component parts through 3D printing, while technically possible, is not economically viable yet as it would involve advanced AM processes with a high production cost.[119]

Reports have suggested that 3D printing could 'enable locally designed solutions for local problems'.[120] While numerous applications have been reported, examples in the South African setting appear to be scarce.[121] This should, however, be highlighted as a promising area for future research.

Over time, more accessible consumer 3D printers[122] with improved technical capabilities could enable the average consumer to effortlessly print more complex objects in a variety of materials.[123] In fact, a number of new processes is slowly making its way to the consumer market.[124]

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[114] In the jusdictions examined.
[115] See E Petersen, R Kidd and J Pearce, 'Impact of DIY Home Manufacturing with 3D Printing on the Toy and Game Market' (2017) 5(3) Technologies 45.
[116] Mendis and Secchi (n 82).
[117] P Li and others, 'Intellectual Property and 3D Printing: A Case Study on 3D Chocolate Printing' (2014) 9(4) JIPLP 322.
[118] 3D Printing is already showing effects on the spare parts market. G Roucolle and M Boilard, '3D Printing Is Already Starting To Threaten The Traditional Spare Parts Supply Chain' (*Forbes*, 6 March 2017) <https://www.forbes.com/sites/oliverwyman/2017/03/06/3d-printing-is-already-starting-to-threaten-the-traditional-spare-parts-supply-chain/#e91321926466> accessed 30 November 2018.
[119] Next to the high costs, other limitations include quality and safety standards, and the availability of design data. Reeves and Mendis (n 51) 19.
[120] WIPO (n 28) 98.
[121] T Schönwetter and B Van Wiele, '3D Printing: Enabler of Social Entrepreneurship in Africa? The Roles of FabLabs and Low-Cost 3D Printers' (2018) Open AIR Working Paper 18 <http://www.openair.org.za/wp-content/uploads/2018/10/WP-18-3D-Printing-Enabler-of-Social-Entrepreneurship-in-Africa.pdf> accessed 10 June 2019.
[122] I n a 2016 survey, 60% of 3D printer owners reported that the printer is somewhat or very difficult to use. HJ Steenhuis and L Pistorius, 'Consumer Additive Manufacturing or 3D Printing Adoption: An Exploratory Study' (2016) 27(7) Journal of Manufacturing Technology Management 990.
[123] Lipson and Kurman (n 1) 84.
[124] Particularly the resin-based processes 'stereolithography' and 'digital light processing'. Stereolithography uses ultraviolet laser to cure layers of a photopolymer resin, while Digital Light Processing cures liquid photopolymers by using a special projector. The process creates smooth

1.3 – The Technical Aspects of the Generic 3D Printing Process

The general 3D printing process consists of three main steps: (i) the creation of the digital model, (ii) the conversion of the model into 3D printer-readable code, and (iii) the manufacturing by adding layers of material together. In many instances, post-processing techniques are applied to both the digital model and the physically produced object.

1.3.1 – Modelling: The Creation of the Computer-Aided Design Model

The cornerstone of the 3D printing process is the CAD model. It forms the digital representation of an object and inherently contains the instructions to physically manufacture the underlying object.[125] This model is subsequently embedded in a CAD-based design file—the format that conveys the digital model and its extrinsic information.[126] CAD models can be created in three ways: (i) by the use of CAD software, (ii) by the use of digital 3D replication technology, such as photogrammetry or 3D scanning, or (iii) through a combination of (i) and (ii).

CAD modelling software can be utilised to either create a digital models from scratch or to adapt and modify existing designs. Pre-existing models often consist of stock models obtained from a stock template library or design sharing platform. Alternatively, consumer-friendly modelling apps and software allow users to create basic 3D models without having to rely on complicated CAD software. These apps provide the user with ready-made models that can be customised using a user-friendly interface.[127]

Digital 3D replication technology creates a CAD model by capturing the geometry of an existing object. Two distinct techniques enable this process: photogrammetry and 3D scanning. Photogrammetry combines multiple photos taken

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surfaced objects with extreme detail, making it a popular production technique in the jewellery and cosmetic dentistry industries for producing castable moulds. At present, various stereolithography and digital light processing printers are available for the consumer market. See <https://all3dp.com/1/best-resin-dlp-sla-3d-printer-kit-stereolithography>. See also A Reichental, 'The Future of 3-D Printing' (*Forbes*, 22 January 2018) <https://www.forbes.com/sites/forbestechcouncil/2018/01/23/the-future-of-3-d-printing/#7246bc7065f6> accessed 30 November 2018.

[125] With the exception of freehand 3D drawing.

[126] For instance, information on the orientation of the model in relation to the printing surface.

[127] For instance, the WIZEgem app lets the user customise readymade models using a user-friendly interface. <https://www.wizegem.com> accessed 30 November 2018.

from different angles, which generally requires a complex and customised system of cameras and lighting, in creating a 3D design.[128] 3D scanning consists of contact 3D scanners that physically probe the object, and non-contact 3D scanners use a feedback device, such as a laser stripe or structured light, to capture the geometry of the object.[129] The various types of 3D scanners and scanning techniques require different levels of user input, manipulation and involvement in the process. Generally, automated scanners are programmed to mechanically scan an object and make a 3D CAD model of it without much human involvement, while non-automated scanners need extensive human involvement in both the scanning itself and the subsequent digitising and adjusting of the model.[130] Nonetheless, most digital models created by 3D scanning require a substantial level of post-processing.[131] The digital model created by using digital 3D replication technology can be used as direct input for a 3D printer, or in a CAD program to edit, add or delete features.[132]

There are various ways to three-dimensionally represent CAD models; most importantly for the purpose of this work are wire-frame models and solid surface models.[133] Wire-frame models depict the geometry of an object as a collection of points and their connectivity—or 'wires'.[134] Their calculations are relatively simple and fast, and wire-frame models are therefore particularly used in creating complex 3D models. Solid models on the other hand represent the volume of an object rather than its lines and surfaces, and provide information on volume, surface and weight. Users can create solid models from the start, or convert wire-frame models into solid models by adding surfaces and volume to the 3D view of the model.

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[128] J Reese, 'The Pros and Cons of Photogrammetry vs. 3D scanning for 3D printed Figurines' (*Mcor blog*, 11 May 2015) <http://mcortechnologies.com/the-pros-and-cons-of-photography-vs-3d-scanning--for-3d-printed-figurines-blog> accessed 30 November. It should be noted that the availability of mobile software allows for the elementary 3D capturing and rendering of objects using a smartphone.

[129] ibid.

[130] See, in general, H Dasari, 'Assessing Copyright Protection and Infringement Issues Involved with 3D Printing and Scanning' (2013) 41 AIPLA QJ 279, 296-305.

[131] See T Weyrich and others, 'Post-processing of Scanned 3D Surface Data' 2004 (Proceedings of symposium on point-based graphics, Zurich, 2-4 June 2004) <http://lgg.epfl.ch/publications/2004/weyrich_2004_PPS.pdf > accessed 30 November 2018.

[132] For example, a 3D scan of a person's face can, with the use of a CAD software, be added to the body of an action figure.

[133] There are mainly three types of CAD models: wire-frame, surface and solid. Surface models solely map out the surface of an object in the digital space and are typically used in architectural illustrations and 3D animation.

[134] Also known as an edge or skeleton representation.

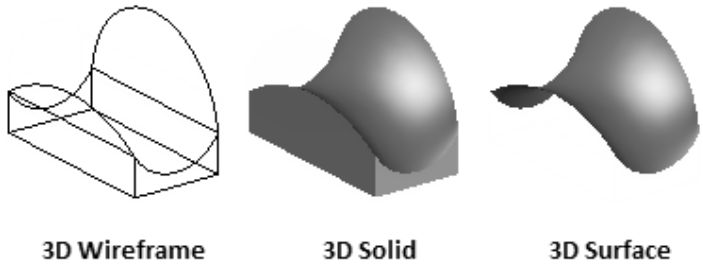

Figure 1 – Representations of CAD Models[135]

The 3D printing process relies on volumetric and boundary information of the object and requires that the CAD model is represented as a solid object[136] and exported in a 3D printing-compatible design file format.[137] The most common and universal file format for 3D printing is STL. This file format describes the surface geometry of a 3D object as a mesh of triangles, which ultimately determines its resolution.[138]

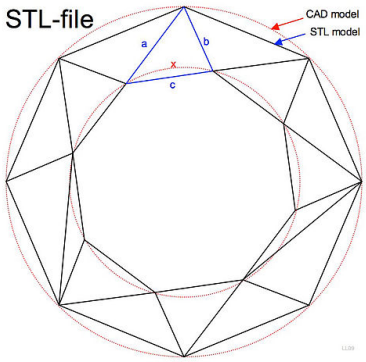

Figure 2 – CAD Model v STL Model[139]

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[135] <https://knowledge.autodesk.com/support/autocad/getting-started/caas/CloudHelp/cloudhelp/2016/ENU/AutoCAD-Core/files/GUID-9DACE807-BC9D-4357-B47E-C6199F6AF1A2-htm.html> accessed 30 November 2018.

[136] It must be noted that there is a 3D printing technique that solely print the wire-frame models named 'WirePrint'. Instead of producing a physical object in a layer-by-layer fashion, this process simply extrudes the thin struts and empty polygons of a wireframe version to speed up the protoptying process. See, S Mueller and others, 'WirePrint: 3D Printed Preview for Prototyping', (27th Annual ACM Symposium on User Interface Software and Technology, Hawaii, 5–8 October 2014) <https://dl.acm.org/citation.cfm?id=2647359> accessed 30 November 2018. This process must be distinguished from wire-frame-*style* models generally found on designs sharing platforms. See, for instance, <https://www.thingiverse.com/search?q=wireframe&dwh=925c36f6c37b8e4> accessed 30 November 2018.

[137] Gibson, Rosen and Stucker (n 3) 4.

[138] Vector-based CAD models ensure an extremely detailed model. The conversion from a vector-based models into triangles inevitably leads to a less detailed model.

[139] <https://upload.wikimedia.org/wikipedia/commons/thumb/d/d7/STL-file.jpg/480px-STL-file.jpg> accessed 30 November 2018.

STL files do, in principle, not contain information on colour and texture. Newer file formats, however, allow for the inclusion of additional information about elements such as the volumetric structure of the interior, geometry, scale, colour, material, lattices, duplicates, and orientation in relation to the printing surface.[140]

1.3.2 – Post-Processing of the Digital Model: The Creation of the Print File

Prior to the printing process, it is essential that the CAD model is examined for errors and embodied in a 3D printing-compatible design file.[141] The 'slicing' process creates the print file that contains user and printer specific instructions for the manufacturing of a particular design.[142] Based on the user's preferences, such as layer height, density, print speed and the addition of support material, software[143] slices the 3D model into two dimensional (2D) cross sections that the 3D printer will lay down, and subsequently creates the 3D printer-readable code, most commonly G-code.[144]

1.3.3 – Printing: Typology of 3D Printing Technologies

The printing process starts with a G-code interpreter reading each line of the print file and sending the corresponding electronic signals to the various 3D printer parts.[145] The printer physically builds the object in an additive fashion—either top-down or bottom-up.[146] After the printing process is completed, post-processing or assembly

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[140] For example, the Virtual Reality Modeling Language (.VRML), Additive Manufacturing File Format (.AMF) and 3MF file format provide more information about the model by allowing for the inclusion of, amongst other things, colour and materials. These file types can be used on 3D printer with more than one extruders or full-colour jetting technology and may soon replace the .STL format.
[141] See generally M Botsch and others, *Polygon Mesh Processing* (A K Peters 2010).
[142] Stereolithography (STL) files describe the surface geometry of a three-dimensional object as a mesh of triangles. STL files do, in principle, not contain information on colour and texture and might soon be replaced by other file formats. Formats, such as Virtual Reality Modeling Language (VRML), Additive Manufacturing File Format (AMF) and 3D Manufacturing Format (3MF), provide more information about the model by allowing for the inclusion of colour, materials, and, in the case of 3MF, orientation and position of the object relative to the print bed.
[143] For example, SkeinForge, Cura and Slic3r.
[144] G-code is an instruction set to control computerised machines. Some 3 printers, such as the Makerbot Rep 2 print from .x3D files.
[145] G-code can be interpreted through firmware in a microcontroller or through use of software.
[146] The most well-known printing process, material extrusion, utilises the bottom-up approach, while other resin-based processes construct the object from the top down. See the discussion below.

may be required to compensate for shortcomings in the 3D printing process or improve the quality of the printed object.[147]

Various 3D printing technologies exist,[148] and the ongoing development of software, printing technologies and materials made it necessary for these technologies to become widely established and standardised. The International Organization for Standardization (ISO) divides the currently available technologies into the following seven groups:[149]

Technology	Description	Materials	Typical market segment
Material Extrusion	Melted material is selectively dispensed through a nozzle or orifice	▪ Polymers	▪ Prototypes ▪ Consumers goods ▪ Tooling ▪ Final parts
VAT Photo Polymerisation	Liquid photopolymer is selectively cured by light-activated polymerisation.	▪ Photopolymers	▪ Prototypes ▪ Jewellery
Powder Bed Fusion	Thermal energy selectively fuses regions of a powder bed.	▪ Polymers ▪ Metals	▪ Prototypes ▪ Tooling ▪ Final Parts
Sheet Lamination	Sheets of material are bonded to form an object.	▪ Metals ▪ Paper ▪ Plastics	▪ Prototypes ▪ Tooling ▪ Final parts (metals)
Binder Jetting	Liquid bonding agent is selectively deposited to join powder materials.	▪ Gypsum ▪ Foundry sand ▪ Polymers ▪ Metals	▪ Prototypes ▪ Patterns for castings ▪ Creative industries ▪ Final parts (metals)
Material Jetting	Droplets of material are selectively deposited.	▪ Photopolymers ▪ Waxes	▪ Prototypes ▪ Moulds for castings ▪ Jewellery
Directed Energy Deposition	Focussed thermal energy fuses materials as they are deposited.	▪ Metals	▪ Final parts ▪ Refurbishment and repair

Figure 3 – Table of 3D Printing Technologies[150]

[147] Subject to the printing process used. Gibson, Rosen and Stucker (n 3) 49.
[148] See Gibson, Rosen and Stucker (n 3). In 2012, there were over 30 different AM technologies. Wohlers Associates, 'Wohlers Report 2012: 3D Printing and Additive Manufacturing State of the Industry' (Wohlers, 2012) <https://wohlersassociates.com/2012report.htm> accessed 9 October 2018.
[149] International Organisation for Standardization (ISO), ISO/ASTM 52900:2015 (2015) <https://www.iso.org/standard/69669.html> accessed 30 November 2018. The standard is currently under review and will be replaced by ISO/ASTM CD 52900. The American Society for Testing and Materials (ASTM), who applied the same standard, has withdrawn it in December 2015. Alternatively, typologies of 3D printing technologies can be based on the printing material, *i.e.* power-based, liquid-based and solid-based. See Bechtold and others (n 47) 10–12.
[150] International Organisation for Standardization (ISO), ISO/ASTM 52900:2015 (2015) <https://www.iso.org/standard/69669.html> accessed 30 November 2018. The structure and content of this table is based upon D de Beer and others, 'South African Roadmap Additive Manufacturing

1.3.3.1 – Material Extrusion – Material extrusion, generally known as Fused Deposition Modelling (FDM) or Fused Filament Fabrication (FFF),[151] is the most common and recognisable type of 3D printing.[152] The material extrusion process constructs an object from the bottom up by selectively depositing materials layer-by-layer. The process extrudes material through a small diameter nozzle at high temperatures, hereafter allowing the layers to cool and bond together.[153] Its use of low-cost material, such as a paste or plastic polymer, and the high production speed make it a preferred means for rapid prototyping and small-scale modelling or manufacturing in the small business and education sectors.[154] Material extrusion is also the technology commonly used in consumer 3D printing hardware. The lack of accuracy of the motors and user calibration, however, limit the resolution of material extrusion.[155] 3D drawing pens, which allow for the freehand creation of 3D objects of variating complexity, also predominantly employ the material extrusion process.

1.3.3.2 – VAT photo polymerisation – Three AM processes currently comprise the VAT photo polymerisation processes: Stereolithography (SLA), Continuous Liquid Interface Production (CLIP) and Digital Light Processing (DLP).

SLA uses ultraviolet laser to cure layers of photopolymer resin.[156] The resolution of SLA printing is significantly higher than extrusion processes and creates smooth surfaced objects with extreme detail, making it a popular production technique in the jewellery and cosmetic dentistry industries for producing castable moulds.[157] The process itself, however, is significantly slower and expensive.[158] CLIP, a variant of SLA, also uses an ultraviolet beam and resin. The difference lies in an oxygen-permeable membrane that lies below the resin, which makes the process

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Strategy' (Commissioned by the Department of Science and Technology, April 2016) 4,5 <https://www.rapdasa.org/wp-content/uploads/2017/02/South-African-Additive-Manufacturing-Strategy.pdf> accessed 30 November 2018.

[151] Fused filament fabrication is the equivalent term for Fused Deposition Modelling (FDM). The FDM process is patented by Stratasys Inc. See US Patent nr. US 5121329A. FDM is a registered US trademark of Stratasys Inc. See US trademark nr. 1663961.

[152] The extrusion process is also used in 3D printing pens, which allow for the freehand creation of objects.

[153] Lipson and Kurman (n 1) 68.

[154] ibid.

[155] ibid.

[156] ibid, 68, 73, 75.

[157] ibid.

[158] ibid.

much faster. This process could potentially create objects 100 times faster than most traditional 3D printing techniques, including material extrusion. Similar to SLA, DLP cures liquid photopolymers by applying light to it, albeit with a special projector instead of a laser beam. DLP offers fast and accurate printing and is mainly used in professional settings. The process has recently been used to cure resin with a smartphone.[159]

1.3.3.3 – Powder Bed Fusion – The powder bed based category covers the groups of methods that use thermal energy to locally bind the powder in the top layer of the powder bed. After the layer is finished, the powder bed is lowered and new powder is swept onto the building bed from a secondary bed.

A first group is selective laser sintering (SLS), which fuses particles together through a high-energy pulse laser[160]. The raw material is in powder form,[161] and also serves as support material for overhanging structures making the creation of support structures unnecessary. Accordingly, SLS can be applied to a variety of materials—plastics, glass, and ceramics.[162] The resulting product is partly porous. Where the sintering process in applied to alloy metal, it is referred to as Direct Metal Laser Sintering (DMLS).

A subcategory of SLS is Selective laser melting (SLM). It uses a high-powered laser beam to fully melt metallic powders into solid three-dimensional parts. Due to the liquidity of the melt, support structures are still required when printing overhanging structures. The SLM process is predominantly used in aerospace and medical orthopaedics industry for the creation of complex items. The Electron Beam Melting (EBM) process is similar to SLM but differs in that is uses a computer-controlled electron beam under high vacuum instead of a laser. The technique is able to melt metallic powder, such as titanium, at high temperatures of up to 1000 °C. The technique is used in the production of aerospace parts and medical implants.

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[159] <https://www.ono3D.net> accessed 30 November 2018.
[160] Lipson and Kurman (n 1) 68, 73, 75.
[161] ibid.
[162] The only requirement is that heating results in binding of the powders.

1.3.3.4 – Sheet Lamination – Two processes comprise sheet lamination: ultrasonic additive manufacturing (UAM) and laminated object manufacturing (LOM). UAM bounds sheets or ribbons of metal together using ultrasonic welding. LOM, on the other hand, uses heat and pressure to fuse layers of adhesive-coated paper, plastic or metal laminates. Unlike UAM, these fused layers then need to be shaped into the desired form by cutting with a computer controlled cutting device, for example a laser or knife. LOM allows for full colour 3D printing. The accuracy of LOM is slightly lower than SLA and SLS. The process is mainly used to produce relatively large parts.

1.3.3.5 – Binder jetting – Binder jetting, also known as 'powder bed printing', 'inkjet 3D printing' and 'drop-on-powder printing', uses a powder-based material and a bonding agent, usually extruded in liquid form, which forms an adhesive between layers of powder. After a layer is finished, the build plate is lowered and the process repeated. The technology is able to print in ceramic, metal, sand and plastic. Moreover, it allows to print in full-colour by adding pigments to the binder. This process is used to print full-colour 3D objects, such as figurines and photos, that do not require high structural integrity and high resolution.

In 2016, Hewlett-Packard introduced the latest advancement in the field of binder jetting: Multijet Fusion (MJF).[163] The technology uses two separate thermal inkjet arrays and combines elements of both inkjet and binder jetting. The first inkjet will lay down the basic building blocks and structure of the part. The second inkjet combines the coating, colour and fusing steps to solidify, texturise and strengthen the part. The printing materials will initially consist solely of a wide range of plastics. At a later stage, however, the company has said to expand the printer's capabilities to include ceramics and metals.

1.3.3.6 – Material jetting – The Material Jetting process, also known as 'multi-jet modelling' and 'inkjet printing', consists of depositing molten wax onto a build platform. A different type of wax with a lower melting temperature is deposited

[163] SJ Grunewald, 'HP Reveals More Info About Their Multi Jet Fusion 3D Printing Technology, Plans for Second 3D Printer' (*3Dprint.com,* 4 January 2016) <https://3dprint.com/113630/hp-multi-jet-fusion-plans-info> accessed 30 November 2018.

below overhangs in the product to act as support material. After completion of the printing process, the object is put in a heated bath that melts away the support material. Multi-jet modelling has become the predominant type of 3D printing technology for the creation of jewels or casts. Similar to this process, Photopolymer Jetting uses various inkjet print heads to deposit bits of build and support. The build material is a liquid acrylate-based photopolymer that is cured by a UV lamp after each layer is deposited,[164] while the support material is later melted or washed away. The most common applications include prototypes used for form and fit testing, rapid tooling patterns, jewellery, and medical devices.

1.3.3.7 – Directed Energy Deposition – Directed Energy Deposition manufacturing processes use a focussed heat source, typically a laser or electron beam, to melt the feedstock material as they are being deposited[165]—predominantly metal powders.[166] The nozzle can move in multiple directions and is not fixed to a specific axis. Subsequently, the feedstock material, which is either in wire or powder form, can be deposited from any angle. This complex printing process commonly used to repair or add additional material to existing components.

1.4 – The Collaborative Aspects of the Creative Process

Technology has dramatically changed the clear division between consumers and creators.[167] Since the 1980's, consumers have increasingly been recognised as an important force for innovation[168] and it has been suggested that 'users are the first to develop many and perhaps most new industrial and consumer products.' [169] Consequently, in the words of Berthon and others: 'the passive consumer is increasingly giving way to the empowered active co-creator, assisted by access to

[164] This is where the technology shows similarities with Stereolithography.
[165] This is where DED shows similarity with material extrusion and differences from powder bed fusion processes.
[166] The process can also be used for polymers, ceramics, and metal matrix composites.
[167] ibid; P Berthon, L Pitt and C Campbell 'Ad Lib: When Customers Create the Ad?' (2008) 50(4) California Management Review 6, 7.
[168] E von Hippel, *The Source of Innovation* (1988 OUP). Consumers as source of innovation gained increased attention when Hendry Chesbrough coined the term "open innovation". H Chesbrough, *Open Innovation: The New Imperative for Creating and Profiting from Technology* (2003 Harvard Business School Press)
[169] E von Hippel, *Democratizing Innovation* (2005 MIT Press) 2.

cheap software, hardware and knowledge.'[170]

Whether one refers to it as decentralised or democratised innovation, at the centre of technology-enabled systems are often users that are increasingly able to create and innovate for and amongst themselves.[171] The phenomenon of user-innovators is a particular feature of the digital environment. Digitisation supports a decentralised system of creativity and innovation, based on peer production and co-creation that increasingly enables consumer involvements in the design creative process and production.[172] This consumer involvement is advantageous not only to the consumers themselves, but to commercial businesses that can potentially benefit from such co-creation activities.[173]

It is essential for the law, including intellectual property law, to recognise the phenomenon of decentralised systems of innovation for society to fully benefit from it.[174] The following subsections introduce interrelated key aspects of decentralised creativity and innovation in order to contextualise the design creative process that underpins the consumer 3D printing ecosystem and its legal implications.

1.4.1 – Customisation

Global competition and advances in manufacturing technologies have pressured companies to increasingly provide tailor made solutions, specifically aimed at consumer needs or preferences.[175] The development and manufacturing of products is, in many instances, no longer based on the needs of a large market segment, and the last decades have been characterised by increased product customisation.[176] Mass-produced products are unlikely to fit the needs of many users, and although

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[170] P Berthon and others, 'Creative Consumers: Awareness, Attitude and Action' (2011) 28(7) Journal of Consumer Marketing 500, 506.
[171] E von Hippel; 'Democratizing Innovation: The Evolving Phenomenon of User Innovation' (2005) 55(1) Management Review Quarterly 63.
[172] Y Benkler, The Wealth of Networks (New Haven, Yale University Press, 2006) 62.
[173] 6.4.2 – Approaches Towards Co-creation and Peer-production.
[174] J de Beer, 'Legal Strategies to Profit from Peer Production' (2008) 46 CBLJ 269.
[175] Such as flexible manufacturing systems, computer-aided design/manufacturing and just-in-time. H Cavusoglu, H Cavusoglo and S Raghunathan 'Selecting a Customization Strategy Under Competition: Mass Customization, Targeted Mass Customization, and Product Proliferation' (2007) 54(1) IEEE Transactions on Engineering Management 12, 12.
[176] Production has developed from centralised manual production to decentralised mass production, to the concept of mass customisation. Y Koren, *The Global Manufacturing Revolution: Product-process-business Integration and Reconfigurable Systems* (2010 Wiley).

consumers may we willing to compromise, they will increasingly demand personalised, customised products and participation in the design process.[177] However, buying customised goods from a manufacturer of customised products is traditionally linked to a high price, and access therefore depends on the consumer's willingness to pay.

While consumers have already been given the opportunity to personalisation through mass-customisation, *i.e.* the production of personalised or customised goods on a large scale at mass-production prices;[178] this expansion of options has always through top-down approach: The producer would provide the customisation options and original consumer input would be negligible.[179] At least for some products and subject to the design dissemination model, 3D printing represents a shift from 'economies of scale' to 'economies of one', and lowers the financial barriers for personal customisation through a bottom-up approach.[180]

Two phenomena that promote both personal and mass-customisation are peer production and co-creation.

1.4.2 – Peer Production (Including Follow-on Creation)

Peer-produced content forms an integral part of today's creative ecosystem.[181] The rise of shared network technologies, characterised by digitisation and the availability of openly licensed content, has faded the traditional distinction between users and creators, and makes it increasingly easy to create, share and access content. Today, much creation and innovation happens in a 'second economy', a distinct but complementary economy based on peer production.[182] Various terms have been used

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[177] von Hippel, *Democratising Innovation* (n 169) 33–43; U Petschow, 'How Decentralised Technologies Can Enable Commons-Based and Sustainable for Value Creation' in Jan-Peter Ferdinand, Ulrich Petschow and Sascha Dicket (eds), *The Decentralised and Networked Future of Value Creation* (2016 Springer), 242.

[178] In its most basic form, mass customisation consists of choosing from a set of predetermined options without actual input and innovation by the consumer.

[179] S Dickel, J Ferdinand and U Petschow 'The Multiple Applications of 3D Printing: Between Maker Movements and the Future of Manufacturing' in Jan-Peter Ferdinand, Ulrich Petschow and Sascha Dicket (eds), *The Decentralised and Networked Future of Value Creation* (2016 Springer), 13–17.

[180] I Petrick and T Simpson '3D Printing Disrupts Manufacturing' (2013) 56(6) Research-Technology Management 12.

[181] von Hippel, *Democratising Innovation* (n 169); E von Hippel, S Ogawa and J de Jong, 'The Age of the Consumer Innovator' (2011) 53 MIT SMR 27.

[182] L Lessig, 'On the Economies of Culture' (*Lessig Blog*, 28 September 2006)

to describe the decentralised system of peer-based creativity, or at least elements thereof; but at the core remains a decentralised system of peer-based creativity that produces commons—goods accessible and belonging to all—rather than commodity.[183] Within the 3D printing ecosystem this commons expresses itself primarily through the free and open digital distribution of design models. While peer production depicts a great step towards decentralised and personalised value creation, the socio-economic benefits of peer production have also been held to be profound.[184]

Commentators have referred to the drivers behind this secondary economy as 'creative consumers' and 'prosumers',[185] which comprises a more general category of creators and innovators that improve functionality or add application to existing works, or enjoy the challenge of experimentation. In other words, the role of the consumers shifts from the traditional passive role consisting of mere use of products, which are generally developed and produced for a large market, to an active role based on personal needs and preferences.

But not all consumers are creators. Digital modelling requires a significant degree of CAD software literacy together with personal attributes, such as creativity and interest in the design creative process. Nonetheless, consumers that lack the ability to create designs themselves have access numerous existing digital models, which can be used and reused to make adaptations or remix.[186] It appears, however, that mainstream users will remain largely dependent on user-creators for the availability of digital models.

Literature discusses the fruits of peer production using divergent terminology.[187] For the purposes of this work the result of innovation based on a decentralised system of peer production is referred to as 'user-generated content' (UGC). UGC not only covers original works,[188] but works that incorporate existing material in a derivative of transformative form. It is here that in the absence of a clear

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<https://www.lessig.org/2006/09/on-the-economies-of-culture/> accessed 30 November 2018.

[183] For instance, Yochai Benkler uses the term commons-based peer production (CBPP) to describe a new models of socioeconomic peer production amongst large numbers of people. Y Benkler, *The Wealth of Networks* (Yale University Press 2006) 60.

[184] Benkler (n 183) 2.

[185] A broad view of prosumer includes consumers that 'hack' or remix existing products. D Tapscott and A Williams, *Wikinomics: How Mass Collaboration Changes Everything* (Portfolio 2006)

[186] Literature generally uses the concepts of reuse, recombination and remixing interchangeably.

[187] Other terms used include user-created content, user-centred innovation, commons-based peer production and community-created content.

[188] In the strict sense of the word.

division, the commercial and 'second economy' overlap. While follow-on creation and innovation can be infringing,[189] it has significant value in contributing to new work and the promotion of the commons. As one commentator points out:

> [C]reation is always the building upon something else. There is no art that doesn't reuse. And there will be less art if every reuse is taxed by the earlier appropriator. Monopoly controls have been the exception in free society; they have been the rule in closed societies.[190]

Indeed, historically creative works have been influenced by, and build upon, previous works. Appropriation art[191] and music sampling are but two examples that illustrate this particular feature in a contemporary setting. In a similar manner scholars point to the key role of reuse in innovation,[192] and the positive effects of the ability to copy on creativity.[193]

User-led creativity and innovation plays a crucial key role in enabling consumer 3D printing where use is largely dependent on peer-creation.[194] In fact, research indicates that follow-on creation, including the adaptation and remixing of designs, is an important 'source of innovation'.[195] For instance, it was found that

> more than half of the content on Thingiverse would not be available if the platform did not explicitly support remixing. It is also plausible to argue that this number may even underestimate the effect because designers self-report remixing.[196]

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[189] See Chapters 2–5.
[190] L Lessig, *The Future of Ideas: The Fate of the Commons in a Connected World* (Random House 2001) 250.
[191] Appropriation art can be defined as art that 'borrows images from popular culture, advertising, the mass media, and other artists and incorporates them into new works of art.' WM Landes and DB Levine, 'The Economic analysis or Art Law' in Victor A Ginsburg and David Throsby (eds), *Handbook of Economics of Art and Culture* 211 (Elsevier 2006), 217. Cf. A Adler, 'Fair Use and the Future of Art' (2016) 91 NYU L Rev 559, 571 n 42.
[192] See, for instance, A Nerkar, 'Old is gold? The Value of Temporal Exploration in the Creation of New Knowledge' (2003) 49(2) Management Science 211; WB Arthur, *The Nature of Technology: What It Is and How It Evolves* (Simon and Schuster 2009); SW Cunningham 'Analysis for Radical Design' (2009) 76(9) Technological Forecasting & Social Change 1138; E Brynjolfsson and A McAfee, *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies* (W.W. Norton & Company 2014); D Strumsky and J Lobo, 'Identifying the Sources of Technological Novelty in the Process of Invention' (2015) 44 Research Policy 1445.
[193] K Raustiala and C Sprigman, *The Knockoff Economy: How Imitations Sparks Innovation* (UOP 2012).
[194] The CAD model is the sine que non for 3D printing.
[195] Kyriakou, Englehardt and Nickerson (n 10); C Flath and others, 'Copy, Transform, Combine: Exploring the Remix as a Form of Innovation' (2017) Journal of Information Technology 1.
[196] Flath and others (n 195) 15.

1.4.3 – Co-Creation

Co-creation exists in various forms, but generally involves shared innovative input at any stage of the production process between either consumers and companies,[197] or consumers amongst each other—a form of peer production.[198] Co-creation between consumers and companies assumes that involving the consumer in the value production helps to better address consumer needs by gaining new insights and knowledge. But one of the results of these activities is increased mass-customised products.[199] 3D printing has the potential to shift this top-down approach (companies to consumers) towards a bottom-up approach (consumer to companies) through peer production and individualised customisation. Empirical research shows that, in general, co-creation in 3D printing between consumers and companies is still in an early stage and not much is known about future synergies.[200]

In affecting different levels of creation and customisation, 3D printing-related co-creation is not only a form of peer production, but it further facilitates and promotes peer production. Companies provide tools and platforms to encourage and enable collaboration amongst users hereby indirectly contributing to the creation of a pool of content. Much of the co-creation in the digital environment occurs independent of any direct company involvement.[201] For instance, through Thingiverse, Makerbot provides online tools for design creation, and a platform for design dissemination, remixing and exchange of printing-related knowledge.[202]

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[197] CK Prahalad and V Ramaswamy, *The Future of Competition,* (2004, Harvard Business School Press). Prahalad and Ramaswamy defines co-creation is this context as 'the joint creation of value by the company and the customer, allowing the customer to co-construct the service experience to suit their context'.

[198] Rayna, Striukova and Darlington (n 48) 91.

[199] It should be noted that mass-customisation not necessarily implicates co-creation activities. C Prahalad and V Ramaswamy, 'Co-creation experiences: The Next Practises in Value Creation?' (2004) 18(3) Journal of Interactive Marketing 5.

[200] R M Ballardini, J Lindman and I Flores Ituarte, 'Co-creation, Commercialization and Intellectual Property – Challenges with 3D Printing' (2016) 7(3) EJLT 1, 11.

[201] Co-creation can also be sponsored where a company provides incentives. V Zwass, 'Co-creation: Toward a Taxonomy and an Integrated Research Perspective?' (2010) 15(1) International Journal of Electronic Commerce 11.

[202] At the same time, many 3D printing-based industries share a common interest with consumers. 3D printer hardware manufacturer Makerbot encourages UGC through its open sharing platform Thingiverse as it sees the availability of 3D printing content as a prerequisite for increased consumer printer sales.

1.5 – Design Dissemination Methods

Digitisation has not only drastically changed the way content is created, but how content is accessed and distributed. The separation of creation and distribution makes the role of physical distributors largely obsolete, and 3D printed goods reach the consumers through various designs dissemination methods. In the context of 3D printing, the dissemination of designs can be either direct, by making the CAD model or print file available, or indirect, by merely offering physical printed versions of the underlying digital models. Divergent levels of openness characterise the different methods through which designs are disseminated, not only with regard to access to the source file, but also regarding licensing restrictions and the charging of fees. Consequently, some commentators have categorised platforms based on their level of openness.[203] For the purpose of this work, however, platforms are categorised based on their form of dissemination. In particular, a distinction is made between the three following categories: (i) digital distribution, (ii) physical distribution and (iii) streaming.

1.5.1 – Digital Distribution

Digital distribution makes the CAD model available to the consumer, either free or at a cost. Access to the source files enables consumers to adapt and customise the design for personal 3D printing; however, it implies a significant loss of control over both the dissemination and integrity of the digital model, and the final materialisation thereof. Transferring manufacturing capabilities to the consumer implies a loss of control over essential characteristics of the product, such as colour, material use and quality, all of which are dependent on the hardware and skills applied used during the 3D printing process.

This method is predominantly used within the consumer 3D printing community which is based on peer-production and thus access to the digital model. At present, there is only one example where an established industry player made digital designs available via this dissemination method. In January 2013, the Finnish

[203] Finocchiaro makes the dinstinction between ‘open model’ services, which allow users to freely exchange designs and advice and ‘money model’ services, which sell digital models or offer 3D printing services. Finocchiaro (n 14) 489.

telecom company Nokia released the designs to facilitate 3D printing of cases for some of its new smartphones.[204] Although the initial design was not optimised for 3D printing[205] and did not embody any of Nokia's trade marks, the later improved version embedded an oversized Nokia logo.[206] The design was made freely available under a Creative Commons - Attribution - Non-Commercial - Share Alike licence.[207]

1.5.2 – Physical Distribution

Physical distribution takes place either via the traditional physical marketplace or on online 3D printing marketplaces and platforms.[208] In the traditional marketplace, these products are sold in an identical matter as any other traditionally manufactured product. In this context, companies increasingly use 3D printing technology to manufacture customised end-products, including hearing aids and eyeglass frames.[209] While the manufacturer can be either the trade mark owner or a licensee, the final products are sold in the retail environment.

More important for the purpose of this article are goods sold through online 3D printing platforms. In this setting, digital models of objects are uploaded to a platform which, in turn, takes care of the on-demand production, payment, shipping and customer service relating to the physical embodiment thereof. The production process includes advanced printing techniques and materials, complemented by consistent quality. Although the CAD models are uploaded to the platform, the consumer will buy an 3D printed object merely based on two-dimensional images of the design and cannot make any changes to the original design.[210] The result is that

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[204] N Lomas, 'Nokia Releases 3D Print Files for Lumia 820 Smartphone. Got A 3D Printer? Custom Print Your Own Removable Shell' (*TechCrunch*,18 January 2013) <http://techcrunch.com/2013/01/18/nokia-releases-3d-print-files-for-lumia-820-smartphone-got-a-3d-printer-custom-print-your-own-removable-shell/> accessed 30 November 2018

[205] T Warren, '3D Printing Your Own Nokia Lumia Case Isn't All It's Cracked Up to Be (Hands-on)' (*The Verge,* 24 January 2013) <https://www.theverge.com/2013/1/24/3909426/nokia-3d-printing-lumia-820-hands-on> accessed 30 November 2018.

[206] Nokia partnered with Makerbot to make an improved version of the original case design. This design is available at <https://www.thingiverse.com/thing:43163> accessed 30 November 2018.

[207] 6.3.2 – Open Source Licensing Schemes.

[208] Alternatively, designs can be manufactured and sold in the regular or online marketplace.

[209] R Sharma, 'The 3D Printing Revolution You Have Not Heard About' (*Forbes*, 8 July 2013) <https://www.forbes.com/sites/rakeshsharma/2013/07/08/the-3d-printing-revolution-you-have-not-heard-about/#c62779e1a6b5> accessed 30 November 2018; Your Eyewear <https://www.youreyewear.com> accessed 30 November 2018.

[210] In some instances the creator offers the object in various materials and finishes, or allows for the consumer to add some customised text or image to the object.

rights holders principally remain in control over both the digital model and the materialised end-product. Through licensing the rights holders authorise the platform to manufacture and distribute the physical objects, while remaining largely in control of the end-result. The final 3D printed product is subject to the rights holders' choice of printing process, materials and colours applied by the service, and thus many of the essential characteristics of the end-product remain under the control of the rights holders.

1.5.3 – Cloud 3D Printing (Streaming)

The idea behind cloud 3D printing is simple: the customisation and slicing of the digital designs happens in the cloud, and after that the print file is streamed to the consumer's printing device.[211] Similar to digital distribution, this model offers consumers access to numerous online designs and allows for customisation of the design albeit often limited by the cloud-based software and the owner's permissions. The consumer selects the slicing settings in the cloud, and subsequently streams the print file directly to his device. Thus, cloud 3D printing retains right holder control over both the design file and final product that is streamed to the consumer. However, the right holder cannot supervise the actual manufacturing process, including the type, colour and quality of the printing material. Further, not only the selected slicing settings, but the user's hardware and its interoperability with the streaming process determine the quality of the final printed object.

A number of design sharing platforms started offering cloud 3D printing, but soon removed it from their services again under pressure of the 3D printing community. The reasons include the lack of customisability within the cloud environment, and difficulties in the technical implementation of cloud-based 3D printing.[212] Currently, none of most prominent design sharing platforms offers cloud 3D printing.[213]

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[211] The definition of cloud computing, its application and the legal issues are outside the scope of this work. Generally, see A Katz, 'The Cloud and the Law' (2010) 196 Copyright World 24.

[212] 'The New Cloud-based Streaming Has Arrived' (*Pinshape,* 11 May 2015) <https://pinshape.com/blog/the-3d-printing-cloud-based-streaming-has-arrived/> accessed 30 November 2018; 'Feature Update: Removing Streaming to Make Designs More Accessible' (*Pinshape*, 17 May 2016) <https://pinshape.com/blog/pinshape-removing-streaming> accessed 30 November 2018.

[213] As established by Memdis and Secchi. Mendis and Secchi (n 82).

1.6 – Conclusion

This chapter has shown that 3D printing in the broad sense, and the dynamic ecosystem surrounding it, have the potential to promote an abundance of creativity and innovation. The technology provides new opportunities for artists, designers and consumers to design, customise and share. At the same time, the decentralisation of design and production facilitates new business models that increasingly incorporate consumer demands and preferences. These new approaches to creation, dissemination and materialisation potentially threatens those actors who rely on intellectual property rights. Until a few years ago, personal 3D printing only reached a niche market of consumers. Nowadays, the technology is becoming increasingly accessible to the mass consumer market; making the questions concerning intellectual property implications all the more relevant. Regardless of its current limitations, the technology has significant legal consequences for existing intellectual property systems—and these consequences are likely to expand in the future. The tension between the open and collaborative nature of the consumer 3D printing community, and the proprietary approach of most rights holders outside of this environment, raises the important question of how intellectual property rights can be safeguarded while promoting the 'second economy' of collaborative creativity.

The following chapters will now explore, in detail, the relationship between 3D printing and the various intellectual property rights, namely trade marks, designs, patents and copyright.

Chapter Two
Contextualising 3D Printing within the Law of Registered Trade Marks

'3D printing […] is shaping up to be the next battleground for intellectual property law overreach, with trade mark law set to play a pivotal role'[214]

2.1 – Introduction

The main discussion surrounding trade mark protection and 3D printing has focussed on the argument that 3D printing will enable 'private counterfeiting', *i.e.* the home-production of imitations of goods bearing trade marks. While the technology allows for such use,[215] the current status of consumer 3D printing minimises the risk of producing substitutable imitations of most goods.[216] Regardless of substitutability, however, marks have already been applied on identical goods for which trade marks are registered.[217] As more users and intermediaries are engaged in potentially trade mark infringing activities, the question whether or not all these actions are permitted under trade mark law becomes pertinent. A universal answer is, however, difficult to formulate.[218]

[214] A Scardamaglia, 'Flashpoints in 3D Printing and Trade Mark Law' (2014-2015) 23(2) JLIS 30, 54.
[215] Not all products can be 3D printed.
[216] At present, the technical capabilities of home 3D printers restrict their application on both a quantitative and qualitative level. 1.3.3 – Printing: Typology of 3D Printing Technologies.
[217] To illustrate, many designs for accessories for Apple products available on Thingiverse embody the Apple logo. See, for example, 'Macintosh Apple mini dock final version (Homage)' <https://www.thingiverse.com/thing:657156> accessed 30 November 2018; 'iPhone 6 Dock w/ Integrated Apple Watch Charging Station' <https://www.thingiverse.com/thing:880490> accessed 30 November 2018; 'iPhone 6/6s stand' <https://www.thingiverse.com/thing:1289078> accessed 30 November 2018; 'Apple Watch and iPhone charging station' <https://www.thingiverse.com/thing:822401> accessed 30 November 2018.
[218] The applicability of trade mark law is dependent on the jurisdiction and sphere (digital or physical) where the actions take place.

In addition to this first question, 3D printing and the mode of design dissemination raise fundamental questions as to the function of trade marks. Through the facilitation of decentralised manufacturing, 3D printing will not only further diminish the waning connection between trade mark owner and the trade marked goods, but will challenge the reasonable belief that the trade mark owners have control over the quality of their products, and how people interact with brands.[219] As trade marks are less and less able to fulfil their traditional functions as indicators of source and quality, the technology ultimately challenges the consumer protection rationale of trade marks. Taking the various models of digital design dissemination into consideration, this chapter explores the potential consequences of 3D printing for the rationale behind the current trade mark system and the projected change in consumers' perceptions and expectations of trade marks. The examination focusses on what use amounts to trade mark infringement, specifically in the context of confusion-based infringement.

2.1.1 – Trade Mark Law

Trade mark law provides the proprietor the exclusive right to prevent others from using the trade mark, or a confusingly similar mark, in relation to goods or services, in a way that will likely damage the rights holder's or the consumer's interest.[220] Registered trade mark protection is, in principle, obtained through application at the national or regional intellectual property office of the jurisdiction for which protection is sought.[221] Upon registration, they are typically granted for a period of 10 years; [222] and can subsequently be renewed indefinitely.[223]

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[219] LS Osborn, 'Trademark Boundaries and 3D Printing' (2017) 50 Akron L Rev 865.
[220] See discussion below.
[221] Under the Madrid System trade mark owners can seek registration in any of the countries that have joined the Madrid Union by filing a single application, or expand the scope a trade mark registration or application, at the 'office of origin'.
[222] The TRIPS Agreement provides that the initial term of protection must be 7 years. TRIPS Agreement, art 18. However, on the national level many countries apply an initial term of protection of 10 years. See, for instance, Trade Marks Act 194 of 1993 (SA), s 37(1); Trade Marks Act 1994 (UK), s 42(1).
[223] ibid.

Substantive trade mark law largely remains a matter of national legislation.[224] The South African law on trade marks is governed by the Trade Marks Act[225] and by the common law.[226] The current Act is based on British[227] and European legislation.[228] Because of the similarities in legal language, British and European judgements have a persuasive authority in interpreting the corresponding provisions in the South African Act.[229] The law of trade marks in the UK is governed by Trade Marks Act 1994, in accordance with European law. The European trade mark system, in turn, rests on the Trade Marks Directive[230] and the EU Trade Marks Regulation.[231] On the one hand, the Trade Marks Directive harmonises the national trade mark systems of the EU member states by requiring them to adopt national legislation in accordance with the provisions of the Directive. On the other hand, the EU Trade Marks Regulation creates a system of trade mark protection at the level of the EU, in parallel to the protection of trade marks available at the level of the Member States according to the national trade mark systems harmonised by the Trade Marks Directive. EU trade mark law on the community level coexists with the national trade mark systems.[232]

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[224] Subject to the requirements provided by the Paris Agreement and the TRIPS Agreement.
[225] Trade Marks Act 194 of 1993 as amended by the Intellectual Property Laws Amendment Act 38 of 1997.
[226] Proprietors of unregistered or common law trademarks can enforce their rights with the common law action for passing off. H Van Heerden and J Neethling, *Unlawful Competition* (2nd ed LexisNexis 2008) 147–94.
[227] British Trade Marks Act of 1994 (Trade Marks Act (UK). The British Act is, in turn, modelled after the Trade Marks Directive.
[228] Directive 95/2008/EC of the European Parliament and of the Council to approximate the laws of the Member States relating to trade marks, originally enacted as Directive 104/89/EEC. Since 2016, the new Trade Marks Directive is into force. Directive (EU) No. 2015/2436 of the European Parliament and of the Council of 16 December 2015 to approximate the laws of the Member States relating to trade marks, [2008] OJ L 99/35.
[229] See, for example, *Beecham Group plc v Triomed (Pty) Ltd* 2003 (3) SA 639 (SCA) 645; *Verimark (Pty) Ltd v BMW AG* 2007 (6) SA 263 (SCA) 268, 270. See also B Rutherford, R Kelbrick and T Rengeca, 'The Law of Trade Marks' in Hennie Klopper and others (eds), *Law of Intellectual Property in South Africa* (2nd ed, 2016 LexisNexis) 103; H Klopper, 'Trade Marks, Domain Names and Dispute Resolution' in Sylvia Papadopoulos and Sizwe Snail (eds), *Cyberlaw@SA III: The Law of the Internet in South Africa* (3rd edn, Van Schaik 2012) 192.
[230] Directive (EU) 2015/2436 of the European Parliament and of the Council of 16 December 2015 to Approximate the Laws of the Member States Relating to Trade Marks [2015] OJ L 336/1 (Trade Marks Directive).
[231] Council Regulation 2017/1001 of the European Parliament and of the Council of 14 June 2017 on the European Union Trade Mark [2017] OJ L 154/1 (EU Trade Marks Regulation).
[232] Trade Marks Regulation, recital 39 of the preamble.

On the international level, the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) provides the most prescriptive rules regarding the protection of registered trade marks.[233] It defines a trade mark as

> any sign, or any combination of signs, capable of distinguishing the goods or services of one undertaking from those of other undertakings.[234]

Trade marks conventionally consist of word marks and device marks, such as logos and emblems; however, nowadays any sign capable of distinguishing, including two- and three-dimensional shapes,[235] configurations, patterns and other non-conventional marks,[236] can function as a trade mark.[237] In order to avoid anticompetitive effects, the law generally restricts the registration of functional or ornamental shapes.[238]

Historically, trade mark law is concerned with confusion.[239] The primary and traditional form of confusion-based infringement entails the use of an identical or similar mark in relation to goods or services for which the trade mark is registered. International trends have broadened confusion-based infringement to cover the use of identical and similar signs in relation to 'similar' goods.[240] Accordingly, trade mark law typically gives the owner of a registered trade mark

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[233] Agreement on Trade Related Aspects of Intellectual Property Rights of 1994 (TRIPS Agreement), arts 15-21. See also N Pires de Carvalho, *The TRIPS Regime of Trademarks and Designs* (Kluwer 2006) 72–77.

[234] TRIPS Agreement, art 15(1).

[235] The registration of three-dimensional shapes as trade marks is typically challenging, particularly considering the prerequisite of distinctiveness.

[236] Non-conventional marks, particularly three-dimensional shapes, are particularly relevant in relation to 3D printing. This work discusses this type of trade marks by not only analysing the application of trade marks *on* CAD models, but *as* CAD models themselves. While a comparision with the US approach towards trade dress could be fruitful, such discussion is beyond the scope of this thesis as US law is not discussed in the context of trade marks.

[237] See, for example, definition of 'mark' in Trade Marks Act 194 of 1993, s 2(1). In the EU, graphic representation is no longer a requirement, provided the mark is represented 'in a manner which enables the competent authorities and the public to determine the clear and precise subject matter of the protection afforded to its proprietor.' EU Trade Marks Regulation, Article 4, letter b; Trade Marks Directive, Article 3, letter b (which will need to be transposed by Member States by January 14, 2019). See also Case C-273/00 *Ralf Sieckmann v Deutsches Patent- und Markenamt*. EU:C:2002:748 [2002], ECR I-11737.

[238] For instance, Trade Marks Act, s 10(5); Trade Marks Directive (EU), art 4(1)(e)(i)-(iii); EU Trade Marks Regulation (EU), art 7(1)(e)(i)-(iii).

[239] For instance, the case law of the Court of Justice consistently emphasises the essential trademark functions of guaranteeing the identity of origin of the trademarked goods or services without causing a likelihood of confusion. See particularly Case C-206/01 *Arsenal Football Club Plc v Reed* [2002] ECR I-10273 [48].

[240] See, for example, TRIPS Agreement, art 16.

> the exclusive right to prevent all third parties not having the owner's consent from using in the course of trade identical or similar signs for goods or services which are identical or similar to those in respect of which the trademark is registered where such use would result in a likelihood of confusion.[241]

Confusion-based infringement embodies the consumer-protection function of trade marks. It generally holds that there is infringement when there is a 'likelihood of confusion' between the respective marks on part of the relevant public. Determining the likelihood of confusion requires that similarity between the marks is assessed based on their overall impression, and taking into account their visual, aural and conceptual similarities.[242] The 'likelihood of confusion' on the part of the public that results from this similarity is examined from the perspective of the 'average consumer'.[243] Whether the goods or services are similar is largely determined by the specification of goods and services within the respective trade mark registrations; however, registration in different classes does not necessarily mean that the goods are not similar.

In addition to confusion-based protection, many countries have introduced anti-dilution provisions. The dilution theory expands trade mark protection beyond consumer confusion and is primarily concerned with protecting the commercial value of trade marks with an increased recognition or reputation. This form of protection focusses on harm to a mark and, therefore, typically does not require 'a likelihood of confusion' or 'use as a trade mark',[244] nor is it limited to non-competitive goods.[245] The dilution theory was first recognised in Europe[246] and later introduced in the South

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[241] TRIPS Agreement, art 16(1).

[242] For instance, on the national level, *Plascon-Evans Paints Ltd v Van Riebeeck Paints (Pty) Ltd* 1984 (3) SA 623 (A) 641; *National Brands Ltd v Blue Lion Manufacturing (Pty) Ltd* 2001 (3) SA 563 (SCA) 568; Case C-251/95 *Sabel BV v Puma AG* [1998] 6 RPC 199; Case C-342/97 *Lloyd Schuhfabrik Meyer v Klijsen Handel*, [1999] ECR I-3819.

[243] See Case C-251/95 *Sabel BV v Puma AG* [1998] 6 RPC 199; Case C-342/97 *Lloyd Schuhfabrik Meyer v Klijsen Handel*, [1999] ECR I-3819. See also 2.3.2 – Confusion-Based Infringement.

[244] Decorative use which merely calls to mind the protected trademark may be held to be infringing use.

[245] Dilution protection is often unnecessarily extended to similar or related goods as to the goods for which the mark is registered. Both the EU and the US apply an extensive application of the dilution system to cases of similar and related goods. The European Court of Justice has held that article 5(2) (now Article 10(2)(c)) must be interpreted contrary to its wording to also protect well-known marks against a third party's use of the mark for similar goods. See Case C-292/00 *Davidoff SA v Gofkid Ltd*, [2003] ECR I-389, [26]. Since 2016, the Trade Marks Directive explicitly uses the wording 'goods or services which are identical with, similar to, or not similar to'. Trade Marks Directive, art 10(2)(c).

[246] It is generally accepted that the dilution theory originates in the German *Odol* case. Landgericht Elberfeld [Civil Court of Elberfeld] in (1925) 25 *Juristische Wochenschrift* 502; (1925) XXV Markenschutz und Wettbewerb 264; [1924] Gewerblicher Rechtsschutz und Urheberrecht (GRUR) 204. For de detailed discussion see B Beebe, 'The Suppressed Misappropriation Origins of Trademark

Africa and the US.[247] The cross-border trade of trade marked goods has led to efforts to harmonise the protection of marks that enjoy an increased recognition or reputation. International agreements and national laws are, however, inconsistent in terminology and provide different scopes of dilution protection.[248] The core condition of the anti-dilution provisions entails use of an identical or similar mark[249] that takes unfair advantage of, or is detrimental to, the distinctive character or the repute of the trade mark.

The TRIPS Agreement allows Member States to introduce limited exceptions to the right conferred in a trade mark, 'provided that such exceptions take account of the legitimate interests of the owner of the trade mark and of third parties'.[250] On the national level, these limitations typically take the form of exceptions for parody.[251]

Antidilution Law: The Landgericht Elberfeld's *Odol* Opinion and Frank Schechter's "The Rational Basis of Trademark Protection"' in Rochelle Dreyfuss and Jane C Ginsburg (eds), *Intellectual Property at the Edge: The Contested Contours of IP* (CUP 2014) 59–80. Some scholars consider the contemporary English case 'Kodak' (*Eastman Phtographic Materials Cp v John Griffith Corp* [1898] 15 RPC 105) as the first case in which protection against dilution was granted. See WJ Derenberg, 'The Problem of Trademark Dilution and the Antidilution Statutes' (1956) 44 California Law Review 439, 449. See also Case C-323/09 *Interflora v Marks & Spencer* [2012] ETMR 1, AG 51. However, as Stephanie Chong points out, this case was mainly decided on the existence of likelihood of confusion, and dilution was merely an additional justification. S Chong, 'Protection of Famous Trademarks Against Use for Unrelated Goods and Services: A Comparative Analysis of the Law in the United States, the United Kingdom and Canada and Recommendations for Canadian Law Reform' (2005) 95 TMR 642, 661.

[247] Inspired by the *Odol* case, Frank I. Schechter introduced the dilution theory in his famous article 'The rational basis of trademark protection'. F Schechter, 'The Rational Basis of Trademark Protection' (1926-1927) 40 Harv L Rev 813. Although Schechter only uses the word 'dilution' once in his article, many scholars argue that he is nonetheless the founder of trademark dilution by challenging the traditional basis for trademark protection. B Mahaffey-Dowd, 'Famous trademarks: Ordinary Inquiry By the Courts of Marks Entitles to an Extraordinary Remedy' (1998) 64(1) Brook L Rev 423, 428; H Carty, 'Do Marks with a Reputation Merit Social Protection' (1997) 19(2) EIPR 684, 684.

[248] Both the Paris Agreement and TRIPS use the term 'well-known marks'. Paris Treaty, art 6bis; TRIPS Agreement, art 16(2)-(3) National laws, courts and commentators use a variety of terms when referring to marks with an increased recognition, amongst others: 'famous', 'well-known' (South Africa), 'known', 'notorious', 'highly renowned', 'mark with a reputation' (EU) and 'mark with market recognition'.

[249] In South Africa the alleged infringing mark must show a more than superficial resemblance or likeness to the well-known mark. *Bata Ltd v Face Fashions CC* 2001 (1) SA 844 (SCA) 852; *National Brands Ltd v Blue Lion Manufacturing (Pty) Ltd* 2001 (3) SA 563 (SCA) 568. In the EU, similarity between two marks is conditional to the relevant public establishing a link between two marks. Case C-408/01 *Adidas-Salomon AG v Fitnessworld Trading Ltd.* [2003] ECR I-12537 [31]; Case C-252/07, *Intel Corporation v CPM* [2008] ECR I-8823, [30], [42]. See also M Luepke, 'Taking Unfair Advantage or Diluting a Famous mark – a 20/20 Perspective on the Blurred Differences Between U.S. and E.U. Dilution Law' (2008) 98 TMR 789, 811.

[250] TRIPS Agreement, art 17.

[251] 2.3.4 – Specific Limitations that Enable .

2.2 – The Impact of 3D Printing on the Functions of Trade Marks

As mentioned earlier, the law has come to recognise two primary and interrelated rationales for trade mark protection: the 'producer incentive' and 'consumer protection' rationales.[252] Under the producer incentive rationale trade marks incentivise rights holders to invest and maintain the quality of their products by giving them property rights to protect their brand value, while the consumer protection rationale protects consumers against confusion with regard to the origin, and subtly, quality of the product.[253] While the law has recognised that the person who produces the trade marked goods is no longer necessarily the registered trade mark owner,[254] decentralised manufacturing through personal 3D printing further diminishes the trade mark owner's ability to exercise control over the end-product—the 3D printed object. The increasingly weak connection between the trade mark and the producer affects consumers' perceptions and expectations of trade marks, which, in turn, determine the extent to which trade marks can fulfil their traditional functions, particularly regarding consumer protection.[255] Remarkably, this impact of 3D printing on the rationale of trade marks has not attracted a great deal of attention from legal commentators.

2.2.1 – The Weakening Connection Between Trade Mark and Producer

Traditionally, trade marks were held to be indicators of the actual origin of the goods to which they were applied for the reason that they identified the manufacturer or physical source of the goods or services.[256] Over time, this 'concrete origin' theory has made place for the 'abstract origin' theory which holds that trade marks can indicate an unknown and anonymous commercial source.[257] The relationship between trade mark and producer has become more remote, and courts broadened their approach to keep pace with the commercial realities, such as the outsourcing of

[252] However, in most cases the law protects both the consumer's and the producer's interests.
[253] The denotation of origin is the primary and traditional function of trade marks in both civil and common law jurisdictions. FK Beier, 'Basic Features of Anglo-American, French and German Trademark Law' (1975) 3 IIC 285, 285-86.
[254] By, for instance, allowing for licensing of trade marks.
[255] As we will discuss in the following sections.
[256] SM Maniatis, 'The Communicative Aspects of Trade Marks: A Legal, Functional and Economic Analysis' (PhD thesis, University of London 1998).
[257] Schechter (n 247) 816.

production and licensing of trade marks.[258] Accordingly, 'trademarks could be understood as indications, not necessarily of physical origin, but of a more general connection between the trademark owner and the trademarked goods'.[259] While performing its origin function to a lesser extent, the primary role of trade marks has become to identify and distinguish between various goods and services;[260] however, concomitantly consumers increasingly perceive trade marks as an indicator of quality.[261] The quality function indicates that all goods bearing the trade mark will be of a consistent or predictable standard of quality, whether manufactured directly by the trade mark owner or by an authorised licensee.[262] Three main factors determine the standard of quality of 3D printed products: (i) the quality and integrity of the CAD model, (ii) the printing settings, and (iii) the printing process, including printing type and hardware used. The method of design dissemination determines the extent to which a trade mark owner effectively *can* exercise control over these factors, and thus the 3D printed end-product.[263]

At the same time, consumer perceptions and expectations shape trade mark law.[264] They particularly influence the extent to which trade marks can perform their traditional functions. Increased awareness of 3D printing's capabilities for creating, customising, sharing and producing objects would lead consumers to clearly distinguish between designers and manufacturers. Apart from increased awareness of the capabilities of 3D printing, the model of dissemination also influences this perception. More specifically, the design dissemination method determines the type

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[258] Trade marks no longer refer to the actual origin of the goods. Rather, trade marks refer to a source and origin, which could be anonymous, to help consumer differentiate between goods and services. The emergence of Internet search engines has further changed the function of trade marks. Consumers started using trade marks as keywords to search for specific brands and proxies for categories of products.

[259] R Denicola, 'Some Thoughts on the Dynamics of Federal Trademark Legislation and the Trademark Dilution Act of 1995 (1996) 58 LCP 75, 77.

[260] The distinguishing function of trade marks has explicitly been recognised by the law and trade marks are defined in terms of their distinguishing function. See Trade Marks Act, s 2(1); Trade Marks Act 1994 (UK), s 1(1); Trade Marks Directive, art 3(a); EU Trade Marks Regulation, art 4(a).

[261] W Cornish, D Llewelyn and T Aplin, *Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights* (8th edn, Sweet & Maxwell 2013) 644–45.

[262] While the trademark owner can authorise the initial download, the later distribution and use thereof can take place without authorisation and in violation of the agreement.

[263] In 1.5 – Design Dissemination Methods.

[264] Consumer-dependant concepts change rapidly as consumer expectations shift in response to market forces, social norms, and other factors. MA Johnson, 'The Waning Consumer Protection Rationale of Trademark Law: Overprotective Courts and the Path to Stifling Post-sale Consumer Use' (2011) 101 TMR 1320, 1323; GS Lunney Jr., 'Trademark Monopolies' (1999) 48 Emory L J 367, 396.

of goods that are retailed—digital or physical—and the extent to which the trade mark owner *could have* exercised control over the 3D printed end-product.

With this in mind, the following question arises: what is the function of trade marks in the consumer 3D printing environment? In answering this question, the following sections address typical consumer perceptions and expectations of trade marks that are used in relation to digital models and 3D printed versions of goods, respectively. Fundamental to this analysis is the distinction between the sale and post-sale environment. The point of sale is the place where the consumer will purchase the respective product—be it digital or physical. The post-sale environment, on the other hand, entails the situation after initial purchase and does not only involve the initial consumer, but bystanders and consumers outside the primary retail environment.

2.2.2 – Digital Models

Consumers come upon digital models at point of sale when design distribution takes place via digital distribution or streaming. The context in which consumers will encounter these models is important as it determines consumers' perceptions of trade marks in the digital environment. Numerous platforms distribute digital models, albeit not via streaming. The distribution of digital models on these platforms is typically accompanied by two-dimensional images of the digital model and an indication of the person who created the design and whether the design was licensed or endorsed.[265] These characteristics are essential elements of design distribution as consumers need to find designs by the use of key terms, including trade marks, and verify that the design they are downloading or buying corresponds with their expectations.

The indication of source in the digital environment primarily occurs through signs external to the digital model—the channel through which the design is offered is but one such indicator. Currently, all platforms that offer digital designs generally indicate the creator of the design and whether the design was licensed.[266] In this

[265] See, for instance, <https://www.thingiverse.com> accessed 30 November 2018; <https://www.turbosquid.com> accessed 30 November 2018. See also LS Osborn, 'Trademark boundaries and 3D printing' (2017) 50 Akron L Rev 865, 882–83.

[266] Based on an analysis of the most prominent 3D printing platforms as established by Mendis and Secchi. Mendis and Secchi (n 82).

context, it is unlikely that a reasonable consumer will consider a material link between a trade mark embedded on a digital model—the internal mark—and the origin of the digital model. By stating that a model is created by a certain entity or person, the platform clearly tells the consumer that this person is the origin of the model, and a reasonable consumer would understand that the internal mark is not related to the source of origin of the model.

Conversely, the absence of any indications regarding the creator of the digital model, or the making available of files through non-official channels would imply that the models do not originate from, or are licensed by, the trade mark owner. Although the design files might initially be authorised by the trade mark owner, further dissemination would prevent consumers to establish the origin or integrity of the files. However, this interpretation might change over time subject to consumer knowledge and awareness of 3D printing, and the context in which digital models are disseminated.

2.2.3 – Physically 3D Printed Goods

Unlike digital models, physically printed goods can be found in both the sale and post-sale environment. Consumers encounter 3D printed objects at point of sale when the design is physically distributed, *i.e.* manufactured by an intermediary via an online platform.[267] This type of manufacturing generally occurs under the supervision of the rights holders, including the trade mark owner. These platforms sell 3D printed objects, and consumers will base their purchasing decision on images of the goods displayed on the platforms' website. Outside of the retail context consumers come across physical goods that are not only the result of supervised manufacturing by the trade mark owner by way of physical distribution, but by private manufacturing through digital distribution and cloud 3D printing. These privately manufactured goods could be either authorised or unauthorised by the respective rights holders. Trade mark owners seem to rarely license designs with their trade mark for private 3D printing, with Nokia being a notable exception.[268] The reasons for this restraint are obvious: private manufacturing implies a loss of control over the 3D printed end-

[267] Physical distribution can also take place via the traditional physical marketplace; however, this is outside the scope of this article and will not be further discussed.
[268] To the best of the current author's knowledge.

product which can lead to, amongst other things, reputational damages and loss of costumers. On the other hand, as was the case for Nokia, licensing a design, including the embedded trade mark, for personal 3D printing could create an incentive for customers to buy the company's main product: in this case the new cell phone.

The point of sale for physical distribution is the online environment. In this context, similar to digital models, 'external signs' rather than 'internal signs' fulfil primary trade mark functions.[269] Regardless of these signs, the actual manufacturer of the physical product is the 3D printing service through which the platform materialises the designs, rather than the trade mark owner. Consequently, consumer knowledge of 3D printing and the physical distribution models determine the extent to which consumers will assume that the physical product is the result of the trade mark owner's safeguarding of quality of the 3D printed object—albeit merely in choosing production method and materials. Nonetheless, the quality of *any* good produced by the 3D printing service will be the same, regardless of whether the design was licensed and actual supervision was exerted by the trade mark owner. The technology, materials, knowledge and skills used for the production process will be the same, and it is the 3D printing service—or rather the mark used by the service—that acts as indicator of origin and quality of the physically produced product rather than mark applied on the design. As the consumer's knowledge of 3D printing and the dissemination methods increases, the role of the (service) mark of the platform providing the goods increases while the role of trade mark embedded on the objects lose their function of indicator of origin of quality of the physical product. At least for marks embedded in the design, this indicates a move away from the traditional trade mark functions as indicator of source of origin and quality towards marks as a signaller of social status and wealth—once the product has been materialised.

Outside the retail context consumers encounter products that are the result of not only physical distribution but home manufacturing through digital distribution and streaming.[270] If the physical object is the result of physical dissemination, trade marks *can* fulfil their primary functions considering the trade mark owner exercises (or at least enjoys the possibility of exercising) control over the 3D printed end-

[269] See, for instance, 'Shapeways Marketplace' <https://www.shapeways.com/marketplace> accessed 30 November 2018; 'i.materialise' <https://i.materialise.com/en/shop> accessed 30 November 2018.
[270] As will be discussed later, for physical goods that are the result of digital distribution or streaming, the point of sale is the point of manufacturing of the good, rather than point of sale of the design file.

product. However, while bystanders can continue to rely on trade marks as source indicators for goods obtained through physical distribution, their perceptions and expectations of trade marks on 3D printed goods will impact the extent to which these marks can *actually* fulfil their functions. Authorised digital dissemination and streaming challenges the reasonable belief that the trade mark owner had, to some extent, control over the quality of the 3D printed products, and it is unclear what assumptions the consumer will make as to the indication of the trade mark. [271] This does, of course, not apply to the consumer who materialises the goods; the consumer is the producer and controls the manufacturing source. It is, however, in the post-sale environment—or rather "post-home-production" environment—that the trade mark perceptions and expectations of bystanders are unclear.

It can be argued that outside the retail context, observers who come across products that are identifiable as 3D printed are likely to assume that manufacturing has occurred without any authorisation, or at least supervision, of the trade mark owner, particularly when the goods are of variable or inferior quality.[272] Indeed, a trade mark owner would most likely want to maintain its reputation and brand value. At present, consumer-produced goods generally show traces of consumer 3D printing hardware, particularly as the result of material extrusion, which produces goods in plastics of which the layers are easily identifiable. However, this differentiation is less clear for goods produced by high-end 3D processes, some of which are slowly making their way to the consumer market.

Consumers might increasingly regard trade marks as an expression of a consumer's affinity with a brand identity, rather than indicators of origin or quality.[273] Nowadays, trade marks go beyond their initial function as an indicator of origin and quality to be regarded as indicators of status, wealth, preferences and aspirations of

[271] It should be noted that traditional counterfeiting, based on large-scale infringement, also affects the consumer's expectation of trade marks. Widespread counterfeiting of a particular product could lead consumers to assume that when such products are encountered in the post-sale environment they are by default counterfeit rather than authentic. 3D printing, however, expands the range of products that can be counterfeited and eliminates the means for effective enforcement.
[272] Scholars have noted a similar shift in consumer perception of trade dress outside the retail context. Desai and Magliocca (n 1144) 1711.
[273] ibid.

the people that use them.[274] Other trade marks appeal to consumers because of what it communicates; it defines a consumer's persona or 'self' by the way the brand makes them feel.[275] Subsequently, trade marks have attained value as products in and of themselves, divorced from any underlying good.[276] In the context of 3D printing, these marks are printed 'as such' or applied to a wide variety of goods, solely subject to the consumer's preference and creativity.[277] Thus, trade marks—especially logos—are likely to be used for their objective signalling of wealth and status, or subjective emotional appeal, rather than to create a perfect imitation. In addition, some commentators argue that consumers might perceive trade marks as indicators of design, rather than as indicators of origin.[278] However, in absence of any knowledge of the dissemination method, this argument fails.

2.2.4 – Conclusion

Production is becoming increasingly decentralised, causing a disconnection between the end-product and the trade mark. While many goods will nonetheless be produced in the traditional setting, the presence of multiple manufacturing and design dissemination options disconnects the trade marks from the manufacturing source. Consumer 3D printing creates a new environment that could change how consumers use, encounter and perceive trade marks, which ultimately challenges the consumer-protection rationale. It is submitted that in the consumer 3D printing environment a combination of objective and subjective factors determine the consumer perceptions and expectations of trade marks, and thus the extent to which trade marks can fulfil their consumer protection function. These factors include the current status of (consumer) 3D printing technology, the general knowledge of 3D printing technology by consumers, and the primary dissemination method applied.

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[274] See T Veblen, *The Theory of the Leisure Class: An Economic Study of Institutions* (new edn, Dover 1994); see also M Pollack, 'Your Image is My Image: When Advertising Dedicates Trademarks to the Public Domain - With an Example from the Trademark Counterfeiting Act of 1984' (1993) 14 Cardozo Law Review 1391.

[275] MA Johnson 'The Waning Consumer Protection Rationale of Trademark Law: Overprotective Courts and the Path to Stifling Post-Sale Consumer Use' (2011) 101 TMR 1320, 1331–33.

[276] See, for example, MA Lemley 'The Modern Lanham Act and the Death of Common Sense' (1999) 108 Yale Law Journal 1687, 1693-94; J Litman, 'Breakfast with Batman: The Public Interest in the Advertising Age' (1999) 108 Yale Law Journal 1717, 1726.

[277] Currently, regarding the current status of consumer 3D printing, the variety of goods is limited to easy printable goods, such as phone cases and keyrings.

[278] J Grace 'The End of Post-sale Confusion: How Consumer 3D Printing Will Diminish the Function of Trademarks' 28 Harv J L & Tech 263, 278.

The ability of trade marks to fulfil this role in the light of the changing consumer perceptions and expectations manifests itself in determining confusion-based infringement. In particular, both the requirements of 'likelihood of confusion' and 'use as a trade mark' are based on how consumers perceive trade marks and the interpretation of the trade mark functions, respectively.[279]

2.3 – Digitisation, Decentralisation and Trade Mark Infringement

Various activities potentially conflict with the rights and interests of trade mark holders: (i) the application of trade marks on CAD models of goods that are identical, similar or unrelated[280] to the goods for which the mark is registered; (ii) the application of 3D marks as CAD models separate from any object; (iii) the physical production of both the aforementioned and; (iv) the use of marks in relation to the design file, including in the file description.[281]

The current trade mark system is based on a business-to-consumer relationship, centralised manufacturing and physical distribution. As will be shown below, this horizontal, centralised approach shows significant limitations to the applicability and enforceability of trade mark law within the 3D printing environment. The changing consumer perceptions and expectations, influenced by the applied mode of design dissemination, further complicate these issues.

2.3.1 – General Limitations to 3D Printing Trade Mark Infringement

2.3.1.1 – Use 'in the Course of Trade' – Trade marks are creatures of commerce, and it is required that the mark is used 'in the course of trade'.[282] While the exact interpretation of this requirement remains contested,[283] it emerges as the main issue that will determine the efficacy of the trade mark system in a decentralised 3D

[279] 2.3.2 – Confusion-Based Infringement; 2.3.4.3 – Use 'as a Trade Mark'.
[280] For dilution-based infringement.
[281] Trade marks applied to CAD models will be marks perceived once materialisation has taken place, and therefore focus will be on CAD models rather than CAD files.
[282] TRIPS Agreement, art 16(1). On the national/regional level see Trade Marks Act 194 1993, s 34(1); Trade Marks Act 1994 (UK), s 10(1); Trade Marks Directive, art 10(2); EU Trade Marks Regulation, art 9(2).
[283] NW Dawson, 'Non-trade Mark Use' (2012) 4 IPQ 204; A Blythe, 'Searching Questions: Issues Surrounding Trade Mark Use on the Internet' (2013) 35 EIPR 507.

printing environment.[284] In this setting, the boundaries between private and commercial sphere become increasingly blurred, which, in turn, emphasises the need for clarification of the 'in the course of trade' requirement. The South African Trade Marks Act does not define this concept, and guidance remains absent from literature and jurisprudence;[285] however, helpful guidance for the interpretation of the concept can be gleaned from jurisprudence from the EU.

In the EU, it has been ruled that there is use in the course of trade when a sign is used 'in the context of commercial activity with a view to economic advantage and not private matter'.[286] While this does not require that the use results in economic advantage or is made with the aim to make a profit,[287] purely personal use, including the private production and use of trade marked goods, cannot be regarded as 'in the course of trade'. Similarly, the sale of privately produced goods would, in principle, fall outside of the scope of trade mark law.[288] More specifically, in *L'Oréal v Ebay*,[289] the (then) European Court of Justice (ECJ) held that only when private sales 'owing to their volume, their frequency or other characteristics […] go beyond the realms of a private activity, the seller will be acting 'in the course of trade' […].[290]

On a national level, in Germany, the one-time sale of infringing goods has been considered non-infringing.[291] Thus, a once-off sale of a privately 3D printed trade marked product would in principle not constitute trade mark infringement, while such sales at increased volume or at a regular frequency would create a *prima facie* presumption of trade mark infringement.[292]

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[284] J Ammar and R Craufurd Smith, 'When a Trade Mark Use is Not a Trade Mark Use? A 3D Perspective' (2015) 1(1) IJLILS 4; R Filitz, J Henkel and J Ohnemus, 'Digital Design Protection in Europe: Law, Trends, and Emerging Issues' Discussion Paper No. 17-007, Centre for European Economic Research (2017) <http://ftp.zew.de/pub/zew-docs/dp/dp17007.pdf> accessed 30 November 2018.

[285] The only South African case that provides guidance on the interpretation of 'use in the course of trade' merely provides that this concept includes trade in goods than in the goods for which the trade mark is registered. *Beecham Group Plc v Southern Transvaal Pharmaceutical Pricing Bureau (Pty) Ltd. and Another* 1993 (1) SA 546 (AD), 20–21.

[286] Case C-206/01 *Arsenal Football Club Plc v Reed* [2002] ECR I-10273, [40]. It is unclear whether economic advantage and private matter are two cumulative requirements.

[287] T Cohen Jehoram, C van Nispen and T Huydecoper, *European Trademark Law* (Kluwer 2010), 266.

[288] For instance, Case C-324/09 *L'Oréal v eBay* [2011] ECR I-06011, [55].

[289] Case C-324/09, L'Oréal v eBay [2011] ECR I-06011.

[290] ibid, [55].

[291] BGH GRUR 2007, 708, 710 - Internetversteigerung II; BGH GRUR 2008, 702 Rn. 43 - Internetversteigerung III; BGH GRUR 2009, 871 Rn. 23

[292] A Kur and T Dreier, *European Intellectual Property Law – Text, Cases & Materials* (Edward Elgar 2013), 197.

These judgements, however, apply to sales of physical items, and their application to digital remains uncertain. The harm in uploading digital models does not necessarily lie with the amount or frequency of uploads, but in that the digital nature of the CAD models allows for indefinite reproduction once they have been uploaded. In other words, would a single uploaded model that becomes accessible to an audience beyond the private sphere amount to use within the course of trade? Intermediaries that host CAD models or facilitate their transfer, even though not for direct financial gain, would nonetheless operate in the course of trade. They host thousands of models that are available to the public with either direct or indirect benefits to the platform.

2.3.1.2 – Use 'in Relation to Goods or Services' – The monopoly provided under the trade mark regime is limited to use in relation to goods or services for which the mark is registered.[293] This (intended) use is reflected in the categories of goods and services for which the trade mark is registered. The Nice Agreement[294] provides for an international qualification system for qualifying goods and services for the purposes of trade mark registration.[295]

The question regarding 'use in relation to goods or services' goes hand in hand with the question whether CAD models are indeed 'goods' under trade mark law. Although the terminology of the relevant provisions appears to be linked to the physical environment, there is no indication that the law excludes use on digital goods. In addition, limiting use to physical goods would effectively divest rights holders of any control of their trade marks within the 3D printing ecosystem where physical production is decentralised and difficult to detect. Moreover, in many instances the digital model and physical 3D printed objects are separated by a few mere mouse-clicks.

With this mind, it is argued there that the use of trade marks both on CAD models or as CAD models, as well as in the design file description can generally be

[293] Identical or similar goods or services for confusion-based infringement, and any goods or services for dilution-based infringement.
[294] Nice Agreement Concerning the International Classification of Goods and Services for the Purposes of the Registration of Marks.
[295] Of 45 classes or goods and services.

seen as a use in relation to the underlying category of goods.[296] Thus, a trade mark registration for vases, for instance, would cover the digital model of vases. Within this reasoning it should be noted that the qualification of 'identical or similar goods' relates to the category of goods for which the trade mark is registered, rather than the state of the goods, *i.e.* physical or digital. However, some commentators argue that CAD models cannot be equated with goods or services covered by the trade mark because it is not the actual product but merely the visualisation that enables the production of the underlying good.[297] This argument, however, appears far-fetched and is arguably contrary to the wording of the law.

It should be noted that many designs consist of trade marks 'as such', and are not used in relation to any goods. Such use is problematic from a trade mark owner's perspective as it does not fall within the ambit of trade mark infringement, but the digital nature of the designs allows consumers to apply these marks digitally to a variety of other designs—which later can be printed. This use likely consists of logo's and other non-conventional marks, and arguably falls within the ambit of copyright law.[298]

2.3.2 – Confusion-Based Infringement

Where there is double identity, *i.e.* identity both as to the mark and the goods or services under consideration, protection is deemed to be 'absolute'.[299] A likelihood of confusion on part of the relevant public does not need to be shown but 'in fact exists by way of legal fiction'.[300] Subject to the general limitations discussed above, establishing identity as to both the signs and the qualification of goods suffices to establish infringement. Non-double identity infringement, on the other hand, requires 'likelihood of confusion'. This concept is informed by the notion of the 'average

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[296] It should be emphasised that 'design files' and 'digital models' cannot be qualified as goods as such.

[297] Ammar and Craufurd Smith compare CAD models to software and argue that CAD software cannot be equated with goods or services covered by the trademark because it is not the actual product but merely enables the visualisation and production of the underlying good. See Ammar and Craufurd Smith (n 284).

[298] See Chapter Five: The Pivotal Role of Copyright within 3D Printing.

[299] TRIPS Agreement, art 16(1). 'In case of the use of an identical sign for identical goods or services, a likelihood of confusion shall be presumed'. See also recital 16 in the preamble to the Trade Marks Directive.

[300] Cohen Jehoram, van Nispen and Huydecoper (n 287) 254.

consumer'.[301] The Court of Justice has held that this consumer is 'reasonably well informed' and 'reasonably observant and circumspect'.[302] However, these default characteristics could differ for specific sectors,[303] and there is much uncertainty as to the attributes of the average consumer in relation to 3D printing technology, dissemination methods and capabilities.[304]

The likelihood of confusion is generally examined at point of sale. This is, for all dissemination methods, the online environment where external factors will fulfil the trade mark functions for the sale of both digital files and physical objects, and thus confusion is arguably absent. The absence of confusion at point of sale could increase the importance of confusion in the post-sale environment. Trade mark law has extended consumer protection to confusion outside the retail context. Post-sale confusion entails a likelihood of confusion that does not (merely) occurs at point of sale, but (also) thereafter—in the post-sale environment.[305] The doctrine was originally developed in the United States,[306] and later in certain circumstances recognised by European jurisprudence.[307] The aim of post-sale confusion is to prevent confusion amongst *prospective* purchasers, rather than (merely) *actual* purchasers.

Some commentators argue that as a result of 3D printing's impact on consumers' perceptions and expectations of trade marks, the form of injury caused by post-sale confusion may cease to exist and the post-sale doctrine could lose its rationale.[308] Compared to traditional cases based on confusion at point of sale or purchase where the injury to the trade mark proprietor follows from the diversion of the plaintiff's customers, injury as a result of post-sale confusion is less self-

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[301] In the assessment of a likelihood of confusion, the CJEU has held that that the concept of the 'average circumspect consumer' applies. See Case C-342/97 *Lloyd Schuhfabrik Meyer v Klijsen Handel*, [1999] ECR I-3819. A similar concept applies in South African law. Rutherford, Kelbrick and Rengecas (n 229) 162.
[302] Case C-342/97 *Lloyd Schuhfabrik Meyer v Klijsen Handel*, [1999] ECR I-3819 [26].
[303] The CJEU has attributed various degrees of attentiveness to purchasers or certain products. The average consumer of motor vehicles, for instance, exhibits a "particularly high level of attention" at point of purchase considering the nature of the goods, the price and the highly technological character. Ruiz-Picasso v OHIM (C-361/04 P) E.C.R. I-643 (First Chamber), [39].
[304] 2.2 – The Impact of 3D Printing on the Functions of Trade Marks.
[305] C Powell, 'We all Know It's a Knock-off! Re-evaluating the Need for the Post-sale Confusion Doctrine in Trademark law' (2012) 14 NCJL & Tech 1, 17–18.
[306] *Mastercrafters Clock & Radio Co. v Vacheron & Constantin-Le Coultre Watches, Inc*., 221 F.2d 464, 466 (2d Cir. 1955). The leading case is *Lois Sportswear, U.S.A. Inc. v Levi Strauss & Co*., 799 F.2d 867 (2d Cir. 1986).
[307] *Arsenal Football Club* (n 286) *Anheuser-Busch* (n 271); Case C-361/04, *Ruiz-Picasso v Office for Harmonisation in the Internal Market* [2006] ECR I-643.
[308] See Grace (n 278) 275.

evident.[309] It has, however, been recognised that post-sale confusion could lead, amongst other things, to devaluation of the brand and reduction of goodwill and sales.[310] These forms of injury, they argue, will not occur as consumers no longer perceive trade marks as indicating source of origin.

However, the impact of post-sale confusion in the 3D printing environment is less than expected. Its application is subject to the design dissemination method, and thus the type of products consumers encounter in the post-sale environment. The distinction between digital models and physical objects in the post-sale environment has thus far gone largely unnoticed, and commentators have only recently addressed this issue; however, without considering the different distribution models.[311]

On the one hand, the post-sale confusion is not applicable to digital files, and thus designs distributed via digital distribution or streaming. The post-sale environment for digital model does not include the CAD model as initially sold, but a copy. Copying is a particular feature of the digital age, and downloading or even merely using a digital model involves making a copy.[312] This also means that bystanders who encounter physical objects that are the result of digital distribution or streaming do not observe the digital object in a post-sale environment, but a 'post-home-production' environment. They do not see, nor are they confused as to the origin of the objects sold—the digital model. Only when the home-produced object is subsequently sold in the course of trade can the right holder can seek recourse based on post-sale—or rather post-home production—confusion. However, in this case the claim will not be towards the person who sold the digital file, but the producer of the physical object.

On the other hand, physical objects that are the result of physical distribution will be encountered in a post-sale environment and could lead to post-sale confusion. In this context, bystanders will observe the object in a post-sale setting where their perceptions of the mark, unlike the initial purchaser, are unlikely to be influenced by external factors. They will perceive the mark without any extrinsic indication that the

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[309] ibid, 272.
[310] The CJEU recognised that post-sale confusion could lead to devaluation of the brand and reduction of goodwill and sales. *Arsenal Football Club* (n 286) [58]–[60].
[311] Osborn analyses the digital file without considering different forms of dissemination. Osborn (331) 889, 890.
[312] HL MacQueen, 'Copyright and the Internet' in L Edwards and C Waelde, *Law and the Internet* (3rd edn, Hart 2009) 191; Efroni (n 2) 203–10.

object was manufactured through a 3D printing platform and whether the underlying design was licensed to the manufacturer. This shift to the internal mark could lead to post-sale confusion.

But what are the attributes of the 'average consumer', the perspective from which the likelihood of confusion must be examined? The first question that arises is as to who is the relevant public that must be confused? Is it the person who would buy the relevant products in the traditional retail context, or is it the person that uses 3D printing platforms that has some familiarity with 3D printing?[313] The answer to this question will subsequently determine the perceptions and expectations of trade marks in the consumer 3D printing environment. These perceptions and expectations are based on the respective public's knowledge of 3D printing, and consumers that are familiar with the 3D printing process are likely to make different assumptions as to marks applied to 3D printed objects compared to those that are less knowledgeable of the technology. This relevant knowledge is, in turn, interrelated with the current status of (consumer) 3D printing technology and the primary dissemination method applied. It entails an understanding of what 3D printing is, what the current capabilities of the technology are regarding, amongst other things, material use and quality, and an understanding of who was ultimately responsible for the manufacturing process. This relationship, it is submitted, implies that the concept of "average consumer" is a dynamic one that is determined by technological premises

2.3.3 – Dilution-based Infringement

Trade marks, particularly marks recognised for their high social status, rely on their reputation and commercial magnetism. The current state of consumer 3D printing technology implies that goods produced using budget consumer 3D printers will most likely be in plastic and of inferior quality.[314] Once these goods are available to the public, the mark thus potentially faces erosion of its repute, distinctiveness, commercial magnetism and selling power. Anti-dilution provisions protect trade

[313] Similar questions have been asked in relation to designs law. See 3.2.1 – The User-based Test that Underpins Designs Protection.
[314] At least compared to the commercially manufactured counterpart.

marks with an increased recognition or reputation against this type of harm.[315]

The core condition of the anti-dilution provisions entails use of an identical or similar mark[316] that takes unfair advantage of, or is detrimental to, the distinctive character or the repute of the trade mark. Thus, four instances can be derived: (i) use being detrimental to the distinctive character; (ii) use taking unfair advantage of the distinctive character; (iii) use taking unfair advantage of the reputation; and (iv) use being detrimental to the reputation. Neither South African Courts, nor the Court of Justice have yet provided further guidance concerning each of these categories and the lack of a clear division between the four cases would allow for the violation of multiple categories by one infringement. In fact, when analysing use taking unfair advantage, the Court of Justice considers both repute and distinctive character together.[317]

Of particular interest to this thesis are uses that are detrimental to (i) the distinctive character or (ii) reputation of a well-known mark. On the one hand, detriment to the distinctive character of a well-known mark, referred to as 'blurring' and 'whittling away', protects the attractiveness and marketing value of a mark. Such detriment generally occurs when a third party uses a well-known trade mark in relation to a variety of products, leading to dilution of the distinctive character of the mark.[318] In *Intel Corporation v CPM*,[319] the Court held that dilution by blurring does not require actual and present injury, but proof 'that there is a serious risk that such an injury will occur in the future'.[320] It went on to clarify that

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[315] South African anti-dilution provisions apply to trade marks that are 'well known in the republic'. In *Triomed*, the court held that this entails the test for 'reputation' as adopted in *McDonald's Corporation v Joburgers Drive-Inn Restaurant (Pty) Ltd*; *McDonald's Corporation v Dax Prop CC; McDonald's Corporation v Joburgers Drive-Inn Restaurant (Pty) Ltd and Dax Prop CC* 1997 (1) SA 1 (A). *Triomed (Pty) Ltd v Beecham Group plc* 2001 (2) SA 522 (T) 556. See also *Safari Surf Shop CC v Heavyweather* [1994] 4 All SA 316 (D). For the UK, see Trade Marks Act (UK), s 10(3).

[316] In South Africa the alleged infringing mark must show a more than superficial resemblance or likeness to the well-known mark. *Bata Ltd v Face Fashions CC* 2001 (1) SA 844 (SCA) 852; *National Brands Ltd v Blue Lion Manufacturing (Pty) Ltd* 2001 (3) SA 563 (SCA) 568. In the EU, similarity between two marks is conditional to the relevant public establishing a link between two marks. Case C-408/01 *Adidas-Salomon AG v Fitnessworld Trading Ltd.* [2003] ECR I-12537 [31]; Case C-252/07, *Intel Corporation v CPM* [2008] ECR I-8823, [30], [42]. See also M Luepke, 'Taking Unfair Advantage or Diluting a Famous mark – a 20/20 Perspective on the Blurred Differences Between U.S. and E.U. Dilution Law' (2008) 98 TMR 789, 811.

[317] Case C-252/07 *Intel Corporation v CPM* [2008] ECR I-8823, [27]; Case C-487/07 *L'Oréal v Bellure* [2009] ECR I-05185, [38].

[318] Kur an Dreier (n 292) 215.

[319] Case C-252/07 *Intel Corporation v CPM*, [2008] ECR I-8823

[320] ibid, [38].

> [p]roof that the use of the later mark is or would be detrimental to the distinctive character of the earlier mark requires evidence of a change in the economic behavior of the average consumer of the goods or services for which the earlier mark was registered consequent on the use of the later mark, or a serious likelihood that such a change will occur in the future.[321]

Blurring encompasses a confined, yet prevalent, category of consumer 3D printing trade mark uses: use of trade marks with an increased recognition or reputation on any desired—particularly non-similar—goods. The frequent use of a (similar) trade marks for non-similar goods can be detrimental to the attractiveness of a renowned mark and lead to the attenuation of the mark's exclusivity and desirability—irrespective of any likelihood of confusion. Alternatively, use of a famous mark in relation to inferior products or portrayed in a negative context is likely to evoke negative thought about the owner's product, leading to detriment to the repute of a well-known mark, also known as 'tarnishment' or 'degradation'. The reputation of a trade mark consists of the goodwill that the public attaches to the mark. Reputation can be based on positive experience with the brand, the history of the brand, but also expectations of exclusivity and prestige. In fact, the association of a mark with a status of exclusivity and wealth is arguably the main reason for using trade marks on consumer 3D printed objects. The use takes unfair advantage of the repute if it creates a transfer of repute from the older mark to the younger.

At present, no tarnishment cases have been decided by the (now) CJEU. However, in *Intel Corporation*, the Court of Justice held as a dictum:

> As regards detriment to the repute of the mark, also referred to as 'tarnishment' or 'degradation', such detriment is caused when the goods or services for which the identical or similar sign is used by the third party may be perceived by the public in such a way that the trade mark's power of attraction is reduced. The likelihood of such detriment may arise in particular from the fact that the goods or services offered by the third party possesses a characteristic or quality which is liable to have a negative impact on the image of the mark.[322]

[321] ibid, [77].
[322] ibid, [40].

Notably, in *Laugh It Off Promotions CC v South African Breweries International (Finance) BV*,[323] later confirmed by the Constitutional Court,[324] the Supreme Court of Appeal in South Africa introduced a general unfairness requirement into the anti-dilution provision.[325] Since then, the trade mark proprietor now has to show an amount of unfairness when proving either unfair advantage or detriment.

2.3.4 – Specific Limitations that Enable Spare Part and Creative Uses

2.3.4.1 – Indicating the Intended Purpose of Spare Parts – A key application of consumer 3D printing is the decentralised production of spare parts. While spare parts are principally protected by designs law, trade marks fulfil a crucial role in communicating their intended purpose. It is indeed imperative that the provider of CAD models of replacement parts can indicate that they fit the genuine goods of the trade mark owner. South African trade mark law provides that the *bona fide* use of a trade mark in relation to goods to indicate the intended purpose of these goods, including spare parts and accessories, does not amount to trade mark infringement.[326] The use must be consistent with fair practice.[327] Similar exceptions can be found in the UK[328] and EU.[329] Under these provisions it is permissible to advertise CAD models of spare parts, or their physical counterpart, by using a trade mark to inform the consumers that the parts fit particular products. The providers must make it unequivocally clear that their goods are not connected in the course of trade with the proprietor of the trade mark.[330]

These exceptions somewhat mirror the image of use 'as a trade mark', as discussed in the following section.

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[323] *Laugh It Off Promotions CC v SAB International (Finance) BV t/a Sabmark International & Another* 2005 (2) SA 46 (SCA).
[324] *Laugh It Off Promotions CC v SAB International (Finance) BV t/a Sabmark International & Another* 2006 (1) SA 144 (CC).
[325] *Laugh It Off Promotions* (n 323) [23].
[326] Trade Marks Act 194 1993, s 34(2)(c).
[327] Trade Marks Act 194 1993, s 34(2). The use must be in accorance with honest practice in dustrial and commercial matters.
[328] Trade Marks Act 1994 (UK), s 11(2)(c).
[329] Trade Marks Directive, art 14(1)(c); EU Trade Marks Regulation, art 14(1)(c). See also Cases C-63/97 *BMW v Deenik* [1999] ECR I-905; C-288/03 *Gilette v LA Laboratories* [2005] ECR I-2337; C-558/08 *Portakabin v Primakabin* [2010] ECR I-6963.
[330] *Commercial Auto Glass (Pty) Ltd v BMW AG* 2007 (6) SA 637 (SCA) 642.

2.3.4.2 – Use 'as a Trade Mark' – In the digital environment many trade marks that are applied to digital designs indicate the idea of the underlying work, rather than the source of the digital model.[331] For example, a digital model of a car, including a car's emblem, would typically not lead consumers to believe that the digital model originates from the car manufacturer; the mark functions to provide authenticity to the object. This is but one example of how use 'as a trade mark' is relevant in the 3D printing ecosystem. Within the 3D printing ecosystem, the question is to what extent the mere fact that a mark is applied to 3D printed goods or their digital equivalent is relevant in determining whether there is 'use as a trade mark'.

To generally avoid granting an over-broad monopoly on trade marks, countries have introduced an extra-statutory limitation to trade mark infringement.[332] The defendant centred approach, followed in South Africa and the United Kingdom, focusses on how consumers interpret the mark, while the proprietor-centred approach, introduced by the Court of Justice, focusses on whether the use affects, or is liable to affect, the functions of the trade mark.[333] The application of both approaches heavily depends on the changing consumer expectations and functions of trade marks, respectively.

South African trade mark law focusses on the consumer's interpretation of the mark. Unlike the previous Trade Marks Act of 1963,[334] the current Act makes no distinction between 'use as a trade mark' and other uses.[335] In *Verimark (Pty) Ltd BMW AG,*[336] later confirmed in *Commercial Auto Glass (Pty) Ltd v BMW AG,*[337] the Supreme Court established that trade mark infringement in double identity cases is

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[331] LS Osborn 'Of PhDs, Pirates, and the Public: Three-dimensional Printing Technology and the Arts' (2014) 1 Texas A&M Law Review 811, 883.
[332] The additional requirements primarily apply to double identity cases. It is submitted that this requirement is superfluous in relation to non-double identity confusion based infringement. As pointed out by Illanah Simon: 'As a practical matter, if consumers do not see the defendant's mark as the source of the defendant's goods (*i.e.* as a trade mark for his goods) they have no reason for confusing the origin of the defendant's goods as a result of the defendant's mark'. I Simon 'Embellishment: Trade mark use triomph or decorative disaster?' (2006) 28 EIPR 321, 322. In line with the CJEU's jurisprudence, which is built around the way issues affect the trademark functions, it is unlikely that such requirement applies to dilution-based infringement.
[333] I Simon 'Embellishment: Trade Mark Use Triomph or Decorative Disaster?' (2006) 28 EIPR 321.
[334] Trade Marks Act 62 of 1963.
[335] Trade Marks Act 1963, ss. 44(1)(a-b).
[336] *Verimark (Pty) Ltd v BMW AG* 2007 (6) SA 263 (SCA); W Alberts, 'Origin of the Species II: The Verimark Case and Trade Mark Infringement' (2007) SALJ 702.
[337] *Commercial Auto Glass (Pty) Ltd v BMW AG* 2007 (6) SA 637 (SCA) 639.

restricted to 'trade mark use', *i.e.* use as a badge of origin.[338] Referring to the narrow approach adopted in *R v Johnstone,*[339] the Supreme Court, in *Verimark*, further explained:

> What is, accordingly, required is an interpretation of the mark through the eyes of the consumer as used by the alleged infringer. If the use creates an impression of a material link between the product and the owner of the mark there is infringement; otherwise there is not. The use of the mark for purely descriptive purposes will not create that impression but it is also clear that this is not necessarily the definitive test.[340]

This narrow view adopted by the Supreme Court implies that trade mark use is a requirement in terms of non-identical infringement.[341] In *Verimark*, however, the Court held that trade mark use is not a requirement for dilution-based infringement.[342]

The EU approach is different. The Court of Justice, in *Arsenal v Reed*[343] introduced an extra-statutory limitation, which holds that the use of an identical sign cannot be prevented unless that use affects the protected trade mark functions, in particular the essential function of guaranteeing consumers of the origin of the goods.[344] In *L'Oréal v Bellure,*[345] the Court of Justice extended the requirement to other trade mark functions, 'in particular that of guaranteeing the quality of the goods or services in question and those of communication, investment or advertising'.[346] Consequently, the consumer's perception of the marks is irrelevant, and infringement solely depends on whether the use affects, or is liable to affect, the various functions of a trade mark. This proprietor-centred approach has not been free of criticism, and much of its interpretation remains unclear.[347]

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[338] *Verimark* (n 336) The question whether non-trade mark use could amount to infringement has been raised a year earlier in *Die Bergkelder*. *Die Bergkelder Bpk v Vredendal Koöp Wynmakery* 2006 (4) SA 275 (SCA).
[339] *Verimark* (n 336) [6]–[7].
[340] ibid. Although this narrow approach is in line with the view adapted by the House of Lords in *R v Johnstone*, it is submitted this approach conflicts with European jurisprudence, the objective of the Trade Marks Directive and article 16(1) of the TRIPS Agreement.
[341] B Rutherford, 'Limiting the Trade-Mark Monopoly: The Nature of Infringing Use' (2007) 40 CILSA 449, 465.
[342] *Verimark* (n 336) [13].
[343] Case C-206/01 *Arsenal Football Club Plc v Reed* [2002] ECR I-10273.
[344] ibid [51]. See also Case C-245/02 *Anheuser-Busch* [2004] ECR I-10989, [59].
[345] Case C-487/07 *L'Oréal v Bellure* [2009] ECR I-05185.
[346] ibid, [58]. The ambiguous definitions and lack of clear boundaries between these 'modern' functions have created tensions within trade mark law. J Tarawneh, 'A New Classification for Trade Mark Functions' (2016) 4 IPQ 352.
[347] See, for instance, Interflora v Marks & Spencer [2013] E.W.H.C. 1291 (Ch) [271]; L'Oréal v Bellure [2010] E.W.C.A. Civ 535, [30]. See also European Commission, Proposal for a Directive of

The application of the decision in *L'Oréal v Bellure* has, however, not been implemented consistently within EU countries. The United Kingdom courts were reluctant to let go of their own 'use as a trade mark' interpretation. Although in *Arsenal Football Club,*[348] the UK Court of Appeal applied the decision by the Court of Justice,[349] the House of Lords later interpreted the decision restrictively by limiting infringing use to 'use as a trade mark', which is held to be in a manner indicating origin.[350] It is argued that such interpretation is inconsistent with European jurisprudence and the objectives of the Trade Marks Directive.[351] The House of Lords further submitted that trade mark use is a pre-requisite for all trade mark provisions in the British Trade Marks Act—including the anti-dilution provisions.[352] Contrarily, on the Community level it has been held that this extra-statutory limitation only applies to the rights conferred in Article 10(2)(a)-(b) (formerly Article 5(1)) of the Trade Marks Directive—*i.e.* to confusion-based infringement.[353] It is submitted that such approach is logical since the conditions of Article 10(2)(c) (formerly Article 5(2))—that the use must take unfair advantage of or be detrimental to the distinctive character or repute of the mark—automatically means that the use is detrimental to the trade mark functions of goodwill and identification.[354]

Whether applying the consumer or proprietor-centred approach, there is arguably no 'use as a trade mark' in the *digital* environment. The origin function and quality function are not fulfilled by external signs rather than the mark applied to the digital model—the 'internal mark'. Consequently, the internal mark cannot act as a 'badge of origin', nor affect these trade mark functions. However, the actual role of internal marks within the 3D printing context remains unclear, and their use could potentially affect other trade mark functions, such as the advertisement and communication function. It further remains uncertain whether these arguments hold

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the European Parliament and of the Council to Approximate the Laws of the Member States Relating to Trade Marks (March 2013) COM/2013/0162 final, 6.

[348] *Arsenal Football Club Plc v Reed* [2003] 1 CMLR 12.

[349] *Arsenal Football Club* (n 286).

[350] *R v Johnstone* [2003] 3 All ER 884 (HL) 889-890.

[351] R Sumroy and C Badger, '"Use in the Course of Trade": Trade Mark Use and the Essential Function of a Trade Mark' in Jeremy Phillips and Ilanah Simon (eds), *Trade Mark Use* (2006) 164.

[352] *R v Johnstone* [2003] 3 All ER 884 (HL) [16].

[353] The case law of the CJEU repeatedly refers to protection by virtue of Article 5(1) (now Article 10(2)(a) and (b)), indicating the limitation applies to both Article 5(1)(a) and (b) (now Article 10(2)(a) and (b)). See, for example, Case C-48/05 *Opel v Autec*, [2007] ECR I-1017, [21]; Case C-254/02 *Anheuser-Busch Inc v Budejovicky Budvar, narodni podnik* [2011] ECR I-02131, [59].

[354] Cohen Jehoram, van Nispen and Huydecoper (n 287) 385.

considering the later materialisation of the design, and the interpretation of this concept becomes increasingly complicated in the post-sale[355] or post-production[356] setting: the *physical* environment. It is likely that the use of a trade mark on 3D printed objects could be perceived as a 'badge of origin', and affect, or at least is liable to affect, the functions of the mark, particularly as indicator of the source of origin and quality. The extent to which this uses affect these trade mark functions is subject to how bystanders perceive these marks and mirrors the discussion as to perceptions and expectations of trade marks in the 3D printing environment as discussed above.

2.3.4.3 – Parody and Remix of Trade Marks – Apart from their role in commerce, many trade marks achieve, in their own right, the status of artistic works or signaller of social status. These situations are a particular feature of the democratised consumer 3D printing environment. The status of trade marks together with increased creativity will lead to new and increased numbers of creative trade mark uses, including parody and remixes. In practice, however, the line between creative works and trade marks may be difficult to draw. Preliminary, it should be noted that uses of trade marks 'as such', *i.e.* without being applied in relation to any good or service, do not fall within the scope of trade mark protection.[358]

Within trade mark law the term parody is widely used to describe the types of cases where an existing trade mark is 'reworked' in some kind of way. There is no definition of parody in trade mark law,[359] but taking in consideration the ordinary meaning of 'parody' there must be an imitation of particular features of the mark with the deliberate exaggeration for comic effect.[360] Next to parody there are artistic expressions that consist of adaptations or remixes of existing marks. Both these uses principally co-exist with traditional trade mark systems that hinges on confusion-

[355] In the case of physical distribution.
[356] In the case of digital distribution or streaming where the consumer produces the physical goods.
[358] These uses could nontheless be actionable under copyright. See Chapter 5.
[359] In the jurisdictions examined. In the EU, the CJEU pointed out that there is no definition of parody in Deckmyn. Case C-201/13 *Deckmyn and Vrijheidsfonds* EU:C:2014:2132, [19].
[360] Parody is a literary composition modelled on and imitating another work, *esp.* a composition in which the characteristic style and themes of a particular author or genre are satirized by being applied to inappropriate or unlikely subjects, or are otherwise exaggerated for comic effect. In later use extended to similar imitations in other artistic fields, as music, painting, film, etc. 'parody, n.2.' (*OED Online*, OUP June 2018) <https://www.oed.com/view/Entry/138059> accessed 30 November 2018.

based infringement. In fact, the very nature of parody is to not create confusion and parodist will actively seek to avoid confusion, making their satirical point clear. Similarly, confusion is generally avoided when remixing marks in artistic expression. The expansion of the dilution doctrine, however, could jeopardise this co-existence and confine these uses and, thus, freedom of expression. As was established earlier, dilution theory is not considered with confusion, and solely aims to protect a mark's reputation—the very aspect parody could potentially affect. Other artistic expressions, including adaptions and remixes of trade marks, could amount to infringement under the confusion- and dilution-based theories in as far as the new expression is substantially similar to the registered mark.

The South African Trade Marks Act does not contain a parody exception. However, in *Laugh It Off Promotions v South African Breweries*,[361] the Constitutional Court confirmed the position of the Supreme Court of Appeal (SCA)[362] that parody is a relevant factor in determining whether the use of a mark is fair in establishing infringement by dilution, but not an absolute defence to infringement.[363] An important step in establishing a defence for parody or remixes consists of the weighing-up of the constitutional right of freedom of expression against the right to intellectual property of the trade mark owner and where appropriate the owner's freedoms of trade, occupation or profession. The anti-dilution provision must be interpreted in the light of the Constitution and applied in a manner that does not unduly trample upon freedom of expression.[364]

While EU trade mark law does not explicitly provide a parody exception,[365] both the EU Trademark Regulation and Trade Marks Directive provide that:

> Use of a trade mark by third parties for the purpose of artistic expression should be considered as being fair as long as it is at the same time in accordance with honest practices in industrial and commercial matters.[366]

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[361] 2006 (1) SA 144 (CC).
[362] 2005 (2) SA 46 (SCA).
[363] *Laugh It Off Promotions* (n 361) [64].
[364] ibid, [18].
[365] In Deckmyn, a copyright case dealing with the so-called paraody exception, the CJEU established that the essential characteristics of parody are 'first, to evoke an existing work while being noticeably different from it, and, secondly, to constitute an expression of humour or mockery'. Case C-201/13 *Deckmyn and Vrijheidsfonds* EU:C:2014:2132. See also Directive 2001/29/EC of the European Parliament and of the Council of 22 May 2001 on the harmonisation of certain aspects of copyright and related rights in the information society [2001] OJ L 167/10 (InfoSoc Directive), art 5(3)(k).
[366] EU Trade Marks Regulation, recital 21; Trade Marks Directive, recital 27.

Furthermore, the Regulation and Directive 'should be applied in a way that ensures full respect for fundamental rights and freedoms, and in particular the freedom of expression'.[367] There is, however, no specific provision dealing with the meaning and scope of a parody and it is left to the discretion of the Member States to adopt a parody exception in their national trade mark legislation. Thus far, such as exception is absent from UK law, and the CJEU is reluctant to uphold the parody defence, particularly in cases of commercial non-authorised use of well-known trade marks.[368]

2.4 – Conclusion

This chapter has shown that trade mark law faces difficulties when dealing with decentralised manufacturing enabled by 3D printing. Both the inherent and external features of consumer 3D printing raise multiple barriers for trade mark owners to uphold their rights, both in the physical and digital environment.

The combination of digitisation and decentralised manufacturing deemphasises the consumer-protection function of trade marks. In the digital environment the function of indicator of source of origin, either to guarantee safety[369] or quality of the file (and indirectly the subsequent physically printed object)[370] is fulfilled by external signs and factors, including the service mark of the platform. For marks embedded to the design, this indicates a move away from the traditional trade mark functions as indicator of source of origin and quality toward mark as signaller of social status and wealth—at least once the product has been materialised. In the physical environment trade marks are, at best, indicators of some form of approval by the trade mark owner.

These changes and their impact on consumer perceptions and expectations of trade marks raise complex questions in determining confusion-based infringement, particularly the consumer-based concepts of 'likelihood of confusion' and 'use as a trade mark'. This work submits that in the 3D printing environment a combination of

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[367] ibid.
[368] See Case T-265/13 *Polo/Lauren v OHIM* EU:T:2014:779. It should also be noted that parody does not automatically constitutes use 'as a trade mark'. See 2.3.1.3 – Us 'as a Trade Mark'.
[369] See, for instance, Desai and Magliocca (n 1144) 1711, 1713.
[370] Flawed design files cause the physically printed objects to be of inferior structural an aesthetic quality. For example, Nokia's initial phone case design showed significant shortcomings and once printed, was prone to breakage. Warren (n 205).

objective and subjective factors determine the consumer perceptions and expectations of trade mark. These factors include the current status of (consumer) 3D printing technology, the general knowledge of 3D printing technology by consumers, and the primary dissemination method applied. However, this set of factors is dynamic, and ultimately it is up to courts to determine the extent to which 3D printing impacts on the function of trade marks.

Chapter Three
Contextualising 3D Printing within Designs Law

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'With the third industrial revolution already here, it is essential for the area of designs protection to be re-examined' [371]

3.1 – Introduction

The digital creation of designs has increased in importance, and computer software performs a central role in executing various forms of design, including industrial design, product design and graphic design. The increased digitisation of design manifests itself within 3D printing through the precondition of a digital model, which inherently also contains instructions to materialise the design. The digital nature of the underlying design has resulted in much of the scholarly debate focussing on copyright;[372] however, digital models and 3D printed goods consist of designs that are subject to registered and unregistered designs law.

There are different ways of protecting designs, not only through designs law, but through copyright, patents and trade marks. International norms allow for a great level of flexibility, and consequently, different jurisdictions apply different design protection regimes based on these models or a combination thereof. For example, the Paris Convention for the Protection of Intellectual Property (Paris Convention)[373] merely contains provisions on national treatment and priority dates of design applications, but is silent on substantive norms.[374] While both the Berne Convention for the Protection of Literary and Artistic Works (Berne Convention) and the Agreement of Trade-Related Aspects of Intellectual Property (TRIPS Agreement)

[371] M Adams, 'The "Third Industrial Revolution": 3D Printing Technology and Australian Design Law' (2015-2016) 24(1) JL Inf & Sci 56, 59.
[372] See 5.2.1 – Qualification.
[373] Paris Convention for the Protection of Industrial Property, Stockholm act 14 July 14, 1967, as amended on 28 September 1979 (Paris Convention).
[374] Paris Convention, art 2 and 4C(1).

require protection for works applied art, industrial design and models, there remains a great discretion as to the scope and nature of protection.[375] The Berne convention, for instance, leaves it to national legislation to

> determine the extent of the application of their laws to works of applied art and industrial designs and models, as well as the conditions under which such works, designs and models shall be protected.[376]

With this in mind, this chapter contextualises the current law of registered and unregistered designs protection within the 3D printing environment. It exposes the threats and opportunities posed by 3D printing technology to designs law and its beneficiaries. The analysis focusses on the prerequisites for protection, and the technology-specific issues surrounding digital models. The inquiry goes on to analyse the impact of 3D printing on design-led innovation, including the extent to which design rights provide rights holders with a suitable mechanism to control their designs and how the law safeguards the availability—through 3D printing—of spare parts.

3.1.1 – Design Rights

Designs protection can be granted for both registered and unregistered designs. Registered designs protection is obtained through application to the national or regional[377] intellectual property office. Upon registration, the right is generally valid for a period of 10 to 25 years.[378] It gives the rights holder a temporary exclusive right to 'use' any items embodying the design and, in turn, prevents third parties from such use without the owner's consent. 'Use' typically includes 'the making, offering, putting on the market, importing, exporting or using of a product in which the design is incorporated or to which it is applied, or stocking such a product for those

[375] Berne Convention, art 7(4); TRIPS Agreement, arts 25 and 26.
[376] Berne Convention, art 7(4).
[377] In the case of a Registered Community Design in the EU.
[378] Art 26(3) of the TRIPS Agreement states that the minimum term of protection is 10 years. Most countries offer a longer term of protection. In South Africa, the term of protection is 15 years for aesthetic designs and 10 years for functional designs. Design Act 195 of 1993 (Design Act), s 22(1). In Europe, term of protection is 5 years, renewable for periods of 5 years to a maximum of 25 years. Designs Directive, art 10 and Community Designs Regulation, art 12.

purposes.'[379] To establish infringement, it is necessary that the allegedly infringing design is identical or substantially similar in overall impression to the registered design.[380]

The unregistered design right (UDR) is considered a hybrid form of copyright and registered designs law.[381] Much like copyright, UDR comes into being automatically, without the requirement of registration, from the date the design is disclosed. In general terms, UDR protection is used to provide protection in industries where registration is inappropriate due to the short-term value of the designs, such as clothing manufacture,[382] and subsists for a substantially shorter term of protection from 3 to 10 years.[383] Unlike registered designs protection, it does not suffice to show that the designs are similar to substantiate infringement; rather infringement of UDR requires an act of actual copying and it is necessary that a causal connection between the two designs is demonstrated.[384] In the EU, both registered and unregistered design rights can exist cumulatively in the same product under the condition that the registered design rights be applied for within a certain time period from the disclosure of the design in order to not forfeit novelty.[385]

3.1.2 – Requirements for the Protection of Designs

3.1.2.1 – South Africa – The Designs Act 195 of 1993 together with the Designs Regulations 1999 govern registered design protection in South Africa. The Act is largely based on the corresponding British forms of protection,[386] and British case

[379] RDA, s 7(2); Designs Directive, art 12(1); Community Designs Regulation, art 19(1). In the same line s20(1) South African Design Act. *Cf*. TRIPS Agreement, art 30.
[380] On the interpretation of this requirement see 3.2.1 – The User-based Test that Underpins Designs Protection.
[381] Cornish, Llewelyn and Aplin (n 261) 613, [15-38].
[382] J Reichman ,'Design Protection and the New Technologies: the US Experience in a Transnational Perspective' (1989) 19 U Balt L Rev 6, 23.
[383] The term of protection for UCD is 3 years with no possibility of extension. Designs Regulation, art 11(1).
[384] For instance, Designs Regulation, art 19(2).
[385] In the UK, this has not always been the case. For an historial overview see L Bently, 'The Return of Industrial Copyright?' (2012) 34(10) EIPR 654.
[386] T Pistorius, S Geyer and A van der Merwe, 'The Law of Registered Designs' in Hennie Klopper and others (eds), *Law of Intellectual Property in South Africa* (2nd edn, LexisNexis 2016) 317–18, and references there.

law has been relied upon in South African design cases.[387] Interestingly, and uniquely, the Act creates a dual register for aesthetic and functional designs—an approach drastically different from any precedent abroad. The Act defines 'aesthetic designs' as

> any design applied to any article, whether for the pattern or the shape or the configuration or the ornamentation thereof, or for any two or more of those purposes, and by whatever means it is applied, having feature which appeal to and are judged solely by the eye, irrespective of the aesthetic quality thereof.[388]

and 'functional design' as

> any design applied to any article, whether for the pattern or the shape or the configuration thereof, or for any two or more of those purposes, and by whatever means it is applied, having features which are necessitated by the function which the article to which the design is applied, is to perform, and includes an integrated circuit topography, a mask work and a series of mask works.[389]

The Act requires both aesthetic and functional designs to be 'novel'.[390] In addition, aesthetic designs need to be 'original', while functional designs must not be 'commonplace in the art in question'. The test for novelty includes comparison of the design against the prior art base, in which the overall impressions are asses 'through the spectacles of a consumer'.[391] In *Homecraft Steel Industries*,[392] Corbett JA held that in its assessment, the court should consider

> how the design in question would appeal to and be judged by the likely customer of the class of article to which the design is applied.[393]

Similarly, the 'eye' through which the visual similarly is assessed for infringement is that of the court, but through the 'spectacles of the customer'.[394] The courts have not established further guidance as to the application of this assessment. The

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[387] See, for example, *Bayerische Motoren Werke Aktiengesellschaft v Grandmark International (Pty) Ltd and Another* 2014 (1) SA 323 (SCA), [9]; *Swisstool Manufacturing Co. v Omega Africa Plastics* 1975 (4) SA 379 (W) 382.
[388] Designs Act, s 1.
[389] ibid.
[390] Designs Act, s 14.
[391] *Swisstool Manufacturing Co v Omega Africa Plastics* 1975 (4) SA 379 (W); *Robinson v D Cooper Corporation of SA* (Pty) Ltd 1984 (SA) SA 699 (A).
[392] *Homecraft Steel Industries (Pty) Ltd v SM Hare & Son (Pty) Ltd* 1984 (3) SA 681 (A).
[393] ibid, 692.
[394] *Swisstool* (n 391).

interpretation of originality means that the design must be the product of the creator's labour and effort. Judicial guidance on the interpretation of 'non commonplaceness' is absent; however, commentators submit that the design should go beyond workshop practices and techniques, and involve a 'a spark of ingenuity'.[395]

3.1.2.2 – European Union – The Designs Directive[396] and the Community Designs Regulation[397] govern design rights. On the one hand, the Design Directive aims to harmonise the national legislations of the Member States in respect of registered designs. The Designs Directive harmonises only in the field of registered designs and in as far as the substantive rules are concerned. It does neither create nor preclude a national system for unregistered designs protection or the protection of designs through competition law.[398] On the other hand, the Community Designs Regulation creates a unified system for both a registered and unregistered design protection at the EU level. Consequently, Member states can potentially offer four types of design rights:[399] national registered and unregistered design rights, and community registered and unregistered design rights.

The requirements for registration of designs are the same for both registered and unregistered community rights. A design is defined as 'the appearance of the whole or a part of an item, which can be resulting from the features of, in particular the lines, contours, colours, shape, texture and/or materials of the product itself and/or its ornamentation.'[400] Protection extends to both two- and three-dimensional items, which entails simple products, component parts of complex products or the overall appearance of complex products. In addition, the designs need to be 'novel' and have 'individual character'.[401] Novelty means that no other identical design has been made available to the public before the date of filing the application for registration of the design for which protection is claimed (for registered designs protection) or before

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[395] A Dunlop, 'A Potent Design' (1995) 3 Juta's Business Law 135, 136.
[396] Directive 98/71/EC of the European Parliament and of the Council of 13 October 1998 on the legal protection of designs [1998] OJ L 289/28 (Designs Directive).
[397] Council Regulation (EC) 6/2002 of 12 December 2001 on Community Designs [2002] OJ L 3/1 (Community Designs Regulation).
[398] Designs Directive, art 16; Designs Directive, recital 7.
[399] It should be noted that in some Member States certain types of designs are also protection under copyright law.
[400] See, for example, Community Designs Regulation, art 3; Designs Directive, art 1(a)-(b).
[401] Community Designs Regulation, art 4(1), 5 and 6.

the date on which the designs for which protection is claimed was first made available to the public (for unregistered designs protection).[402] It requires a comparison between the overall appearances of the design and the prior art base.[403] Individual character requires that the design must produce an overall impression on the 'informed user' that is different from the overall impression produced on this user by any other designs which have been made available to the public before relevant date.[404] The 'informed user' is defined as 'particularly observant and [with] some awareness of the state of the prior art, that is to say the previous designs relating to the product in question'.[405]

3.1.2.3 – United Kingdom – In the United Kingdom, the Registered Designs Act[406] (RDA) governs the law relating to registered designs, while the Copyright, Designs and Patents Act[407] (CDPA) governs the law relating to national unregistered design rights.[408] The requirements relating to EU registered designs apply *mutatis mutandis* to UK registered designs.[409] This means that the scope of registered designs protection is equally broad. Unlike the pre-harmonisation registered designs regime, the definition of 'designs' now includes both aesthetic *and* functional designs.[410] In absence of harmonisation on the EU-level, the UK maintains a unique *sui generis* UDR regime.

The UK UDR regime was developed to remedy the strange results of so-called 'industrial copyright' under which, prior to 1988, non-registrable functional designs could obtain copyright protection. It introduced short-term, automatic sui generis protection for original functional designs. It limits the scope of designs to the shape or configuration of an article[411] and explicitly excludes surface decoration.[412]

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[402] Where priority is claimed, the start date is the date of priority. Community Design Regulation, art 5; Design Directive, art 4.
[403] See infra registration and 'making available to the public'.
[404] Community Design Regulation, art 6; Design Directive, art 5.
[405] Case C-281/10 P, *Pepsico v Grupo Promer* [2011] ECR-10153, [62].
[406] The Registered Designs Act 1949 (RDA).
[407] Copyright, Designs and Patents Act 1988 (CDPA).
[408] CDPA, ss 213–245.
[409] Through harmonisation by the Design Directive.
[410] The previous British Registered Designs Act 1949 defined 'designs' as 'features of shape, configuration, pattern or ornament *applied to an article by an industrial process*, being features which in the finished article *appeal to and are judged by the eye*' (emphasis added).
[411] CDPA, s 231(2). The section does no longer apply to 'any aspect' of the shape or configuration and, consequently, an unregistered design will not exist in small and trivial details of a part of an article.

UDR exists in 'original' designs, *i.e.* designs that are not commonplace in the design field in question at the time of its creation,[413] from the moment they are recorded in a design document or an article is made to the design. A design is original if it is not 'commonplace in the field of question', and has not been copied from another pre-existing design—so-called originality 'in the copyright sense'.[414] In particular, the original the shape and configuration of CAD models would attract UDR once the model has been saved as a design file or physically produced using a 3D printer.

The rationale behind this particular regime has been largely undermined by the harmonisation of EU registered designs law and the creation of an unregistered Community designs regime.[415] As discussed above, designs protection on the EU-level includes both aesthetic and functional designs.[416]

3.1.3 – Limitations to Design Protection

The TRIPS Agreement allows Members to provide in their national legislation limitations to the protection of industrial designs, as long as they do not 'unreasonably conflict with the normal exploitation of protected industrial designs and do not unreasonably prejudice the legitimate interests of the owner of the protected design, taking account of the legitimate interests of third parties.'[417] Broadly, limitations within design law play a crucial role on two levels: exclusions from eligibility for design protection, and exceptions and defences against infringement. For the purposes of this thesis, limitations on the protection of spare parts are dealt with as exclusions from eligibility.[418]

The reasoning behind these limitations vary. For example, EU designs law excludes designs dictated solely by their technical functions in order to prevent

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[412] CDPA, s 213(3)(c).
[413] In a qualifying country, such as the UK and Member States of the EU. CDPA, s 217(3).
[414] See, for instance *Ultraframe v Eurocell Building Plastics* [2005] RPC 7, [110]. See also *Farmers Build Ltd v Carier Bulk Materials Handling Ltd* [1999] RPC 461, 481.
[415] The CJEU also plays a crucial role in the harmonisation of copyright, with potential implications for the designs regime. See Bently (n 385).
[416] 3.1.2.2 – European Union.
[417] TRIPS Agreement, art 26(2). This formulation shows analogy with the three-step test found in copyright law.
[418] 3.4.3 – What about Spare Parts? The qualification of limitations on protection for spare parts is unclear. For the purposes of this work, they are dealt with as exclusions from eligibility. See, however, Arnold J in *BMW AG v Round & Metal Ltd* [2013] FSR 18 Ch D. (UK).

technical innovation being hampered[419] by enabling obtaining 'monopolies over technical solutions without meeting the more stringent conditions laid down in patent law.'[420] In a similar manner, designs that mandate interoperability of products are equally excluded to enable competition in the secondary market.[421]

3.2 – Subjective Appraisals and Democratised Creativity

3.2.1 – The User-based Test that Underpins Designs Protection

The requirements for registration of a design together with the exclusive rights conferred on the rights holder determine the scope of protection in a registered design.[422] The interpretation of key conditions within each of these two factors is established by a user-based test, which is likely to give rise to subjective appraisals within the 3D printing ecosystem. Traditionally, designs were aimed at a specific consumer group, *i.e.* consumers who would buy and use a particular physical product. However, in the 3D printing environment, designs, both in digital and physical form, are available to a broad audience that not only consists of passive consumers, but user-innovators. The latter group is not only concerned with merely using the design but is involved in the customisation and follow-on creation of existing digital designs.

Both the test for registration and infringement of a design involve an identical concept. In particular, the requirements of novelty in South Africa, and individual character in the EU, are examined through the perspective of a 'consumer' and 'informed user', respectively.[423] This test is mirrored in the test to determine infringement.[424] Below, the term 'user' is used when dealing with these concepts

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[419] Community Designs Regulation, recital 10; Designs Directive, recital 14.
[420] Case R 690/2007-3 *Lindner Recyclingtech GmbH v Franssons Verkstader AB* [2010] ECDR 1 [28].
[421] ibid.
[422] In addition, limitations to design protection play a double role within determining both protectable subject matter and infringement. See 3.4.3 – What about Spare Parts?.
[423] In the EU, the requirements of individual character and novelty to some extent overlap and the perspective from which novelty should be assessed remains unclear. While the General Court has held that novelty should be addressed from an objective point of view, it did not answer the question which perspective differences should be assessed. Case T-68/11 *Erich Kastenholz v OHIM* EU:T:2013:298.
[424] In South Africa, a similar test applies in the assessment of whether a design is aesthetic or functional. See 3.1.2.1 – South Africa.

from a jurisdiction-neutral perspective.

It is contended that democratised creativity might demand a reassessment of this user-based standard. The judgment of this concept arguably differs for CAD models and physically printed items. For example, in the EU, commentators have argued that the user of CAD models is the person utilising the 3D printing platforms, rather than the person who buys the product in the traditional retail context.[425] However, users are increasingly involved in the design process, and the distinction between 'users' and 'experts in the field' likely becomes blurred. Subject to 3D printing becoming more widespread, technical constraints will likely influence the overall impression by the user.

This is particularly the case in the EU where 'individual character' is assessed from the perspective of the 'informed user',[426] and is the result of a four-tier test.[427] Two factors of this test, the identity of the users of those products, and the designer's freedom in developing the design, complicate the test in the 3D printing environment.[428] The previous sections have established that there is debate as to the identity of the user of digital and physical design, respectively. It is further unclear how the freedom of the designers will be assessed. On the one hand, the designers' freedom is lower because of the increasing number of companies and individuals that design CAD models.[429] In this context, increased creation could saturate the field of design, and subsequently minor changes could lead to a different overall impression on the part of the respective user. At least for some applications design limitations constitute another factor that limits designers' freedom and could further contribute to

[425] V Elam, 'CAD Files and European Design Law' (2016) JIPITEC 151, [83]–[85].
[426] In *Pepsico v OHIM*, the Court of Justice explained the concept as […] lying somewhere between that of the average consumer, applicable in trade mark matters, who need not have any specific knowledge and who, as a rule, makes no direct comparison between the trade marks in conflict, and the sectoral expert, who is an expert with detailed technical expertise. Thus, the concept of the informed user may be understood as referring, not to a user of average attention, but to a particularly observant one, either because of his personal experience or his extensive knowledge of the sector in question. Case C-281/10 P, *Pepsico v OHIM* (Grupo Promer) [2011] ECR I-10153, [53].
[427] H&M Hennes & Mauritz BV & Co. KG v OHIM – Yves Saint Laurent (handbags) T-526/13, 32-34. The test includes examining the sector to which the product belongs, the identity of the users of those products, the designer's freedom in developing the design, and the outcome of the comparison of the designs at issue.
[428] The requirement that freedom of the designer is examined in establishing individual character is explicitly mentioned in the Community Design Regulation and Design Directive. See Community Design Directive, art 6(2); Design Directive, art 5(2).
[429] EUIPO case law has established that the crowdedness of a certain field, and technical constraints, limits the degree of designer's freedom. See, for example, OHIM Third Board of Appeal, in Mafin S.p.A. v Leng-D'Or S.A., decision of 4 November 2010, 20–21.

a lowering the bar. Material extrusion, for instance, requires the designer to take into account overhanging parts and support structures. On the other hand, the technical capabilities of 3D printing enhance the designer's freedom by allowing for the creation of increasingly complex geometries that cannot be created using traditional manufacturing methods.[430] Examples of such complex designs are manifold.[431]

3.2.2 – What do Absolute and Qualified Protection mean for the Consumer?

Registered design rights are 'true monopoly rights'.[432] Registration of a design, followed by publication thereof, acts as notice to third parties. Therefore, intent and knowledge do not form a pre-requisite for registered design infringement, and the proprietor can object to the use even if the design was independently created. The rights holder is merely required to show that the new design produces the same overall impression as a registered design. While it is reasonable for mass manufacturers to research on design protection, this places a heavy burden on consumers who download, customise and 3D print CAD models without knowledge of prior art. The result is a high likelihood for consumers and other parties to unintentionally and unknowingly infringe a third party's design rights.

Similar to copyright, UDR will only be infringed when there is actual copying, which can be either direct or indirect.[433] In the 3D printing environment proof of copying will often consist of indirect evidence, such as proof of access and similarity.[434] More than relatively minor changes are likely required to avoid substantial similarity.[435] Conversely, the making of articles to a design which was independently created does not amount to infringement of the design right. It is arguably easier to find independent creation within the consumer 3D community considering most actors are hobbyist, enthusiasts and makers unfamiliar with the prior art made available to the public.[436]

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[430] Designs that cannot be created using traditional manufacturing techniques are referred to as "impossible designs".
[431] For examples, see H Bensoussan, 'Benefits of 3D Printing: Impossible Designs and Internal Channels' (*Sculpteo Blog*, 18 January 2017) <https://www.sculpteo.com/blog/2017/01/18/3d-printing-benefits-impossible-designs-and-internal-channels> accessed 30 November 2018.
[432] D Musker, *Community Design Law: Principles and Practice* (Sweet & Maxwell 2002) 66.
[433] CDPA, s 226(4).
[434] *Fulton v Grant Barnett* [2001] RPC 257.
[435] *Ultraframe v Eurocell Building Plastics* [2005] RPC 7.
[436] Nordberg and Shovsbo (n 472) 294.

3.3 – The Protection of Designs in CAD Models

3.3.1 – Protecting CAD Models in Their Own Right

Section 1(1) of the South African Designs Act protects designs applied to an 'article', which is defined as an 'article of manufacture'.[437] Its EU and UK counterparts refer to 'products' which are, in turn, defined as 'industrial or handicraft items'.[438] The result of these definitions is that some commentators have looked at the possibility of protection of CAD models in their own right, particularly as graphic symbols.[439] In fact, the European Union Intellectual Property Office (EUIPO) allows for registration of visual aspects of computer programs, such as icons, screen displays and graphic user interfaces.[440] Such an analogous application seems problematic considering digital images solely occur on a computer screen, while CAD models have the characteristics to be physically manufactured. CAD models thus apply a design to a digital product.[441]

Registration of a design requires disclosure. As will be shown in the next subsection in more detail, disclosure does not involve the application of a design on a physical item, but includes a wide variety of publications, including through graphical representation. Hence, the fact that the design solely exist in digital form does not preclude the existence of design protection. Subsequently, registration must be done in the relevant underlying product category of the Locarno classification.[442]

3.3.2 – Disclosure Through CAD Models

The fundamental principle underlying design protection is disclosure, which starts the term of protection. In return for a temporary monopoly, the design becomes part of

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[437] The tern 'article' is also used under the UK UDR regime. CDPA, s 213(2).
[438] Community Design Regulation, art 3(a)–(b); Design Directive, art 1(a)-(b); RDA (UK), s 1(2)–(3).
[439] For instance, T Margoni, 'Not for Designers: On the Inadequacies of EU Design Law and How to Fix It' (2013) 4(3) JIPITEC 225; Elam (n 425).
[440] See EUIPO Guidelines for Examination of Registered Community Designs, version of 01/08/2016, 4.1.3.
[441] Margoni (n 439) [47].
[442] CAD models for which design protection is sought for the underlying design must be registered in the relevant product category of the underlying products and not in the class for blueprints (*i.e.* class 19-08 for 'other printed matters'). See The Locarno Agreement Establishing an International Classification for Industrial Designs.

the pool of 'prior art' and becomes available for the public to use after expiry of the relevant rights. Disclosure can take place through registration for registered design protection, which requires the submission of a 'graphic representation' of the design, or through other forms of publication for UDR. Two questions arise in this context:

- To what extent can CAD models be used as graphical representations to obtain *registered* designs protection?
- To what extent does the publication CAD models initiate *unregistered* designs protection?

These questions are addressed in the following sections.

3.3.2.1 – The Implications of CAD models for Obtaining a Registered Designs Protection – In South Africa, the registration process takes place at the Companies and Intellectual Property Commission (CIPC), either by hardcopy registration process or through e-filing. Yet, even though a digital filing system is in place, representations can only be submitted as drawings or photographs, and a CAD model will not be accepted during the registration process.[443]

The registration process in the EU is predominantly digitised.[444] EUIPO administers the registration process under the registered design regime. The application must, amongst other things, include a reproducible representation of the design.[445] The Community Design Implementation Regulation[446] sets forward further administrative requirements, including that the design is submitted in at least one protected view,[447] represented on a neutral background,[448] and submitted in a specified data format.[449] Subject to the general requirements for graphical

[443] CIPC, 'Apply' <https://www.cipc.co.za/index.php/trade-marks-patents-designs-copyright/designs/344> accessed 30 November 2018.
[444] EUIPO advises to use its online registration platform considering the time and quality constraints of hardcopy registrations via fax.
[445] The application for a registered Community design must contain `a representation of the design suitable for reproduction'. Community Design Regulation, art 36(c).
[446] Commission Regulation (EC) 2245/2002 of 21 October 2002 Implementing Council Regulation (EC) No 6/2002 on Community Designs [2002] OJ L 341/28 (Community Design Implementation Regulation).
[447] But no more than seven different views. Community Design Implementation Regulation, 4(2).
[448] Community Design Implementation Regulation, 4(1)(e).
[449] Community Design Implementation Regulation, 4(1)(d).

representations,[450] CAD models are eligible for graphical representation before the EUIPO. In fact, the office accepts 3D dynamic views submitted in three specific CAD file formats,[451] and the EUIPO Guidelines for Examination of Registered Community Designs explicitly state that 'computer-made representations or any other graphical representations are accepted, provided they are suitable for reproduction'.[452] The actual manufacture of the design is probably not necessary in order to trigger the design right.[453] EUIPO is not concerned with whether the product is, or can be, actually made or used in determining whether or not to grant a registered community design.[454] In line with the EU, the UK IPO allows for representation of a design in computer-generated (CG) graphic images, such as CAD models.[455]

However, even when possible, the use of CG graphic images, including CAD models, in a design application should subject to caution.[456] While the representation through CAD models can be beneficial as it enables applicants to disclose features which may not be discernible in others way of representation, such as surface decoration,[457] CG graphic images could create uncertainty regarding the subject matter for which protection is claimed. This is because they can fail to convey the design information and often lack a clear way to disclaim elements of the design for which protection is *not* sought. Applicants should ensure that the digital models accurately reflect the elements wherefore protection is sought and not more.[458]

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[450] EUIPO, 'Guidelines for Examination of Registered Community Designs – Examination of Applications for Registered Community Designs', version 01/08/2016 (2016), 3.3.1 <https://euipo.europa.eu/tunnel-web/secure/webdav/guest/document_library/contentPdfs/law_and_practice/designs_practice_manual/WP_2_2016/examination_of_applications_for_registered_community_designs_en.pdf> accessed 30 November 2018.

[451] EUIPO accepts .obj, .stl, and .x3d file formats. <https://euipo.europa.eu/ohimportal/en/attachments> accessed 30 November 2018.

[452] EUIPO, 'Guidelines' (n 450) 17.

[453] Margoni (n 439) [47]. It should be noted that most CAD models must be submitted according to the requirements set forward in the Community Designs Implementation Regulation. Commission Regulation (EC) 2245/2002 of 21 October 2002 Implementing Council Regulation (EC) No 6/2002 on Community Designs [2002] OJ L 341/28.

[454] See EUIPO, 'Guidelines' (n 450) 4.1.

[455] UK IPO, 'DPN 1/16: Guidance on Use of Representations When Filing Registered Design Applications' (2016) <https://www.gov.uk/government/publications/designs-practice-notice-dpn-116/dpn-116-guidance-on-use-of-representations-when-filing-registered-design-applications> accessed 30 November 2018.

[456] See *PMS International Group Plc v Magmatic Limited* [2016] UKSC 12.

[457] In a drawing.

[458] For instance, EUIPO allows for the exclusion of certain features from the scope of protection through the use of boundaries, colouring, shading and broken lines. However, it is unclear how such exclusions can be applied to 3D CAD models, particularly represented as solid objects.

3.3.2.2 – The Implications of CAD models for Obtaining Unregistered Designs Protection – Recognising the different scope of the UK and EU UDR,[459] their automatic protection is subject to some form of disclosure of the design. The European UDR subsists from the moment the design is used or 'made available to the public' within the EU.[460] A design is made available to the public when the design is 'published, exhibited, used in trade or otherwise disclosed'.[461] This provision is subject to the so-called 'safeguard' clause which stipulates that making available shall only have taken place if it happened 'in such a way that, in the normal course of business, these events could reasonably have become known to the circles specialised in the sector concerned, operating within the Community'.[462] EUIPO case law indicates that the publication of a design on a non-restricted website in itself constitutes disclosure.[463] This is even so if the circles specialised in the sector concerned are not aware of the website.[464] Considering the above case law which focusses on retrievability, it appears that even designs uploaded to websites not hosted within EU countries not only become part of the state of the art within the EU, but that such uploads also commence UDR protection. However, a literal interpretation of the Regulation, particularly Article 110a(5) CDR, may suggest the opposite.[465]

The specific scope of the UK UDR regime appears to be more lenient to protecting designs, in this case limited to the shape or configuration of an article, captured in a CAD model. It merely requires that the design be recorded in a design document or an article must be made to the design'.[466] This would include both the expression of a design in CAD models and printed objects.

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[459] See 3.1.2.2 – European Union; 3.1.2.3 – United Kingdom.
[460] Community Designs Regulation, art 11 in combination with art 110a(5).
[461] Community Designs Regulation, art 11(2).
[462] ibid.
[463] For instance, OHIM Third Board of Appeal, decision of 26 March 2010 (Case R 9/2008-3); OHIM Invalidity Division, *Mariusz Adamski Adams Group v Abakus Direct Ltd*, decision of 10 July 2014.
[464] U Suthersanen, *Design Law: European Union and United States of* America (2nd ed, Sweet & Maxwell 2010) 126
[465] Elam (n 425) 154.
[466] CDPA, s 213(6).

3.4 – Digitisation, Decentralisation and Designs Infringement

Decentralised manufacturing is set to lead to increased infringement of design rights. To establish infringement, the design must be identical or substantially similar in overall impression to the registered design. This section assumes that similarity between the two designs has been established.

In the physical environment the enquiry is relatively straight forward. The person who 'makes', *i.e.* 3D prints, a product that embodies a protected design without authorisation of the rights holders, infringes the design rights.[467] 'Making' is likely to be interpreted in a technology-neutral way to include 3D printing. Interestingly, some jurisdictions extend 'making' to the person who 'directs, causes or procures the product to be made by another'.[468] Accordingly, the person who instructs a 3D printing service to print an infringing design is liable, even though he did not 'make' the article himself. However, the decentralised nature of the direct infringement makes it difficult to detect, and infringers are in large numbers, difficult to locate, or arguably not worth suing. The subsequent dealing with infringing products, including the offering, putting on the market, importing and exporting, generally amounts to secondary infringement.

In addition, the designs regime does not provide protection against indirect material use of the design by, for instance, prohibiting the supply of digital versions of the design to enable the 'making' of a product by embodying the registered design. For this reason, it is critical to address the extent to which design rights can be used to prevent other forms of exploitation that do not involve the making of material objects, but the creation and dissemination of digital models embodying the design. Subsequently, the question as to whether the scope of design rights covers digital, immaterial designs becomes pertinent.[469]

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[467] Subject to exceptions. See 3.4.3 – What about Spare Parts?; 3.4.4 – Reconciling Exceptions with a Decentralised Environment.
[468] For example, Australia. See *Review Australia Pty Ltd v Innovative Lifestyle Investments Pty* (2008) 166 FCR 358, 363 (per Jessup J). It should be noted that the acts of making are territorially linked.
[469] Particularly in the light of the copyright-design overlap. See 5.4.1 – Copyright-Design.

The table below shows the limited and uncertain application of designs law throughout the 3D printing process.

Activity	Actor	Potential Infringement
Creating CAD models, including 3D scanning, modification and remix	User	Making of a Design Document (UK UDR); Use?
Sharing, including the act of copying a file to a folder which is publicly available and uploading a file to a file sharing platform	User Design Sharing Platforms	Use?
Downloading, including downloading CAD models from a hosting website or third party's storage device	User 3D Printing Service	Use?
3D Printing, including 3D printing through digital dissemination and streaming	User 3D Printing Service	Making the Design
Enabling infringement	ISP Design Sharing Platforms 3D Printing Technology Providers	Authorising the making of an infringing article (UK UDR)

Figure 4 – Infringement under the Traditional Conception of Design Rights

3.4.1 – Equating CAD models to Physical Goods

Designs protection generally involves a 'design' applied to an 'item' or 'product'. In the 3D printing context, prior to being physically 3D printed, designs only exist in digital form—as CAD models embedded in a design file. At this stage, the design merely appears as a digital model on a computer screen. This raises the question as to whether a CAD models can qualify as a registrable design?

In answering the question whether CAD models can be equated to physical objects, two schools of thought exist. Conventional scholarship argues that infringement only occurs when there is a physical product, and use of a CAD model embodying a design does not amount to infringement.[470] According to these scholars, a CAD model is 'a digital representation of the product and not a product created by the registered owner that exercises any of the exclusive rights in the registered design'.[471] This perspective significantly limits the right holders' ability to enforce

[470] See, for instance, M Hall, '3D Printing – Same of the IP Challenges' (2013) AIPJ 213, 214; Adams (n 371) 70; Similarly, Bradshaw, Bowyer and Haufe argue that design files solely concern copyright law. Bradshaw, Bowyer and Haufe (n 110) 20.
[471] Adams (n 371) 70. See also Hall (n 470) 214.

their rights against intermediaries considering the design regime does not provide protection against indirect use of the design.

A second school of scholars consider the closeness between the digital and physical world and finds such application unduly restrictive.[472] The primary consideration is that CAD models present the object exactly as it would appear in the physical world—in three-dimensions—and they can largely be considered equal to physical embodiments of the design. The arguments of most commentators within this second group are based on European legislation. In the EU, both the Designs Directive and the Community Designs Regulation grant the designs rights holder 'the exclusive right to use it and present any third party not having his consent from using it'. The notion of 'use' is wide,[473] and although the definition seems to be constructed for the physical environment, it does not appear to exclude use of the design as or in immaterial media, such as CAD models.[474] According to Margoni, the central question is whether or not the immaterial design creates the same overall impression on an informed user as the material design.[475] Other commentators point to case law by the German Supreme court,[476] which recognised protection of the 'design as such'.[477] However, it remains unclear whether this interpretation will be accepted by the CJEU and national courts.

3.4.2 – The 'Design Document' under National UDR

In absence of harmonisation by the Designs Directive, the UDR regimes on the national level differ. Under the UK UDR regime the reproduction of a design by making articles to that design amounts to primary infringement. Users and intermediaries also infringe UDR by importing for commercial purposes[478] and

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[472] Elam (n 425) [130]-[131]; A Nordberg and J Shovsbo, 'EU Design Law and 3D Printing: Finding the Right Balance in a New E-Ecosystem' in Rosa Maria Ballardini, Marcus Norrgård and Jouni Partanen (eds), *3D Printing, Intellectual Property and Innovation – Insights from Law and Technology* (Wolters Kluwer 2016) 285–86.
[473] Suthersanen (n 464) 134.
[474] Margoni (n 439) [43], [44]. See also L Bently and B Sherman, *Intellectual Property Law* (4th edn, OUP 2014) 755, fn 56.
[475] ibid, [45].
[476] BGH, Judgment of 7 April 2011 – I ZR 56/09 (KG) ICE, GRUR 2011, 1117.
[477] Nordberg and Shovsbo (n 472) 285.
[478] CDPA, s 227(1)(a).

dealing[479] with infringing articles which they know or have reason to believe are infringing.[480] Similarly, a person who authorises a third party to make an article to a protected design also infringes the UDR.[481]

Important for the purpose of this analysis is section 226(1)(b) of the CDPA. According to this provision, the making for commercial purposes of a 'design document' embodying the design, for the purpose of enabling physical articles to be made, constitutes infringement.[482] CAD models are likely to qualify as design documents.[483] It is not required that the design documents are actually used to create the physical item as long as the purpose of the making of the design documents is to enable the manufacturing. The provision is limited to the making for commercial purposes, and consequently a user is allowed to make CAD models for personal and private purposes without infringing the UDR.[484] Notably, and perhaps counter-intuitively, acts other than the 'making' of the CAD models, including the subsequent dissemination, reproduction and even sale in the course of business of CAD models for the purpose of enabling 3D printing, do not amount to infringement.[485]

3.4.3 – What about Spare Parts?

A series of explicit exclusions narrows the scope of design protection (and thus potential infringement).[486] These exclusions generally relate to the functionality of the design, and concern:

- features dictated solely by their technical function;
- 'must-fit' features[487] – features (of complex products) that are technically necessary as to enable interconnection with the product in which or in

[479] Which includes possessing for commercial purposes, and selling, letting for hire, or offering or exposing for sale or hire, in the course of a business. CDPA, s 227(1)(b)–(c).
[480] CDPA, s 227(1).
[481] CDPA, s 226(3)
[482] CDPA, s 226(1)(b).
[483] While the Act does not provide a general definition for 'design document', it is submitted that the provision-specific definition found in section 51 of the Act applies.
[484] Acts are done in relation to an article for commercial purposes if it is done with 'a view to that article being sold or hired in the course of a business'. CDPAs s 263(3).
[485] Primary infringement solely applies to the 'making' of the design document. However, dealing with infringing design documents does not amount to secondary infringement because design documents are explicitly excluded from the definition of 'infringing articles'. CDPA, ss 227(1)(c) and 228(6).
[486] The TRIPS Agreement provides that Members may provide that design rights 'shall not extend to designs dictated essentially by technical or functional considerations'. TRIPS Agreement, art 25(1).
[487] Also known as the 'interface' features.

connection which it must operate;

- 'must-match' features[488] – features which must be reproduced to the same design so as to conform aesthetically — rather than technically — to the appearance of the larger product of which they are intended to form part; and
- designs that go against morality.

It should be noted from the outset that some exclusions do not relate to the design itself, and thus the scope of design protection, but to the production thereof. South Africa, for instance, explicitly excludes designs that are not intended to be manufactured by an industrial process.[489]

The following sections analyse select regional and national exclusions. Particular focus is on the extent to which repair in the form of 3D printing of spare parts is allowed under the current regime.[490] Exclusions to design protection are supplemented by exceptions against infringement, which are discussed in the following section.[491]

3.4.3.1 – South Africa – The South African Designs Act excludes once-off designs from protection and demands that designs for articles are 'intended to be multiplied by an industrial process'.[492] Although the Act does not define 'industrial process', it has been put forward that even a rudimentary manufacturing process would satisfy this requirement.[493] It remains unclear, however, how this requirement will be interpreted in relation to the 3D printing process that *potentially* allows for the industrial multiplication of a multitude of articles. The decentralised nature of the manufacturing process causes uncertainty as to the protection of designs that merely exist in digital form without any guarantee of materialisation. It must be noted that, in

[488] 'Must-match' features can be dealt with as exceptions to infringement. For purposes of the structure of this work, we deal with this clause under exclusions.
[489] See 5.2.3.1 – South Africa.
[490] The qualification of limitations on protection for spare parts is unclear. For the purposes of this work, they are dealt with as exclusions from eligibility. See, however, Arnold J in *BMW AG v Round & Metal Ltd* [2013] FSR 18 Ch D. (UK). See also, 3.3.3.2 – European Union/United Kingdom.
[491] 3.4.4 – Reconciling Exceptions with a Decentralised Environment.
[492] Designs Act, s 14(4).
[493] Pistorius, Geyer and van der Merwe (n 386) 241.

contrast to most jurisdictions, the design of a part of an article is only protectable when it is manufactured separately.[494]

The Act contains two exceptions that apply to aesthetic designs and one exception specific to functional designs. In particular, section 14(5) excludes from the protection of aesthetic designs a 'feature of an article in so far as it is necessitated solely by the function which the article is intended to perform' and the 'method or principle of construction' of such a design. In relation to functional designs, the Act excludes the features of pattern, shape or configuration of 'an article which is in the nature of a spare part for a machine, vehicle or equipment'.[495]

To qualify as an aesthetic design, the design does not need to be exclusively aesthetic, but can contain both aesthetic and functional features.[496] It must, however, appeal to, and be judged solely by the eye, irrespective of the aesthetic quality thereof. This entails a consumer-based test. In *BMW v Grandmark,*[497] in dealing with the design of a bonnet, a grille, a headlight assembly, and a front fender, the Supreme Court of Appeal held that

> the eye through which the design must be judged is that of the likely customer, who will choose it so as to maintain the form of the vehicle. Indeed, it can be accepted, from their nature, that most customers will not even see the component before it is fitted to the vehicle, nor make any selection at all, other than by giving instructions for the restoration of the vehicle.[498]

This judgement is important in relation to spare parts, which are generally selected purely for purposes of restoring the product to its original or functioning state. Spare parts selected for their function would accordingly be excluded from aesthetic design protection, and be considering as functional designs. Subject to the interpretation of the functional design-specific exclusion relating to spare parts, many of these designs would, in turn, be excluded from design protection. Conversely,

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[494] Designs Act, s 1(1), definition of 'article'.
[495] Designs Act, s 14(6).
[496] *Bayerische Motoren Werke Aktiengesellschaft v Grandmark International (Pty) Ltd and Another* 2014 (1) SA 323 (SCA), [7]. The functional features will be excluded from the scope of protection.
[497] Ibid.
[498] ibid, [14].

spare parts selected for their eye appeal could nonetheless be eligible for aesthetic design protection and avoid the spare parts exclusion.[499]

3.4.3.2 – European Union – The exclusions under the Community Designs Regulation and Design Directive are similar.[500] This section is based on the language in the Community Designs Regulation. They exclude three types of designs from the definition of 'design'. First, it excludes designs that are 'contrary to public policy or to accepted principles of morality'.[501] Of greater importance for this analysis, however, are exclusions relating to the functionality of the design. In this context, the Regulation excludes 'features of appearance of a product which are solely dictated by its technical function'.[502] Designs that include functional features, but not solely comprise of such elements, are nonetheless protectable to the extent of their aesthetic features. After some uncertainty, EUIPO,[503] national courts[504] and ultimately the CJEU[505] have adopted the 'causative approach', which holds that a design is solely dictated by its function when it originated from purely functional considerations.[506] Conversely, where features were chosen to improve the product's visual appearance, the design is not solely dictated by the function.

The second exclusion relating to functionality entails 'must-fit' features, *i.e.* 'features of appearance of a product which must necessarily be reproduced in their exact form and dimensions in order to permit the product in which the design is incorporated or to which it is applied to be mechanically connected to or placed in,

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[499] The Supreme Court of Appeal recognises that certain component designs are capable of being registered as aesthetic designs. *BMW* (n 496) [15].
[500] With the exception of the 'spare parts' solution.
[501] Community Designs Regulation, art 9. Article 8 of the Design Directive contains an identical provision.
[502] Community Design Regulation, art 8(1). Art 7(1) of the Design Directive provides for an identical provision.
[503] See OHIM Invalidity Division*, Lindner Recyclingtech GmbH* ICD 3150, decision of 3 April 2007, [28]-[36]. See also OHIM Third Board of Appeal, *Nordson Corporation v UES AF* – (Case R 211/2008-3) decision of 29 April 2010) [26]–[35].
[504] See, for example in the UK, *Dyson Ltd. v Vax Ltd* [2010] EWHC 1923 (Pat) [23]–[31]. See also *Samsung Electronics v Apple* [2012] EWHC 1882 (Pat) [36]–[38].
[505] C-395/16 *DOCERAM GmbH v CeramTec GmbH* EU:C:2018:172.
[506] *Cf*. The 'mandatory' or 'multiplicity of forms' test holds that a functional design may be nonetheless eligible for protection if it can be shown that the same technical function can be achieved by another different design. Case C)299/99 *AG Ruiz-Jarabo, Philips v Remington* [2002] ECR I-5475, [34].

around or against another product so that either product may perform its function'.[507] However, designs 'serving the purpose of allowing multiple assembly or connection of mutually interchangeable products within a modular system' are deemed protectable.[508] There has been no judicial consideration on this point and, in insofar as spare parts are concerned, this exclusion turned out to be rather redundant. The reason for this is that many spare parts for cars or household appliances will be hidden from everyday use and, therefore, be excluded from design protection. The Regulation explicitly excludes 'under the bonnet' or non-visible spare parts from its scope.[509] As component parts of complex products, these parts are only considered in the assessment of the design when they are visible in 'normal use'. Article 4(3) of the Regulation defines 'normal use' as 'use by the end user, excluding maintenance, servicing or repair work'.[510] Thus, the nominal end user, and what they can see, determines the scope of designs protection. The interpretation of visibility-in-use by the General Court[511] and EUIPO[512] has been reasonably consistent and entails a relatively strict interpretation of use by the end user'.[513] Parts that are visible, but of which the design solely dictated by their technological function, are anyway excluded from protection.

Despite years of discussion, the issue surrounding 'must-match' features has not been resolved yet on the Community level. The Design Directive does not regulate 'use of the design of a component part used for the purpose of the repair of a complex product so as to restore its original appearance'. Instead the so-called 'freeze-plus' or 'status quo' position was adopted.[514] The existing limitation on spare parts on the level of the Member States remained in force[515] while amendments are

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[507] Community Design Regulation, art 8(2). Art 7(2) of the Design Directive provides for an identical exception.
[508] Community Design Regulation, art 8(3).
[509] Design Directive, art 3(3)(a); Community Design Regulation, art 4(2)(a). D Musker, 'Hidden Meaning? UK Perspectives on Invisible in Use Designs' (2003) 25(10) EIPR 450.
[510] Designs Regulation, art 4(3); Community Designs Directive, art 3(4); RDA (UK), s 1B(9).
[511] Case T-11/08 *Kwang Yang Motors v OHIM* (9 September 2011)
[512] OHIM Third Board of Appeal, decision of 8 November 2012 (Case R 1512/2010-3) *Cezar Przedsiebiostwo Prodkcyjne Dariusz Bogdan Niewinski v Poli-eco Tworzywa Sztucze*.
[513] See, for a somewhat broader interpretation, OHIM Third Board of Appeal, decision of 22 October 2009 (Case R 690/2007-3) *Lindner Recyclingtech GmbH v Franssons Verkstader AB* [2010] ECDR 1.
[514] Design Directive, art 14. This clause is also called the 'freeze-plus' clause.
[515] See, for example, RDA (UK), s 7A(5) (relating to registered designs); CDPA, s 213(3) (relating to unregistered designs).

only allowed if 'the purpose is to liberalise the market for such parts'.[516] The Community Design Regulation mirrors the provision set forth in the Directive in the co-called 'repairs clause'. It provides that until entry into force of a final Community-wide solution:

> protection as a Community design shall not exist for a design which constitutes a component part of a complex product used within the meaning of Article 19(1) for the purpose of the repair of that complex product so as to restore its original appearance.[517]

In the joined cases *Acacia v Audi, and Acacia v Porsche AG,*[518] the CJEU clarified that for a component part of a complex product to qualify under the repairs clause, it is not required that 'the protected design is dependent upon the appearance of the complex product'.[519] In this particular case, the rims of a car were held to be components parts of the complex product, *i.e.* the car design. The Court further requires the spare part to be of 'identical visual appearance to that of the part which was originally incorporated into the complex product when it was placed on the market'.

The repair clause has been interpreted on the national level of the UK in *BMW v Round and Metal*.[520] Arnold J held that Article 110(1) CDR acts as a defence, rather than an exclusion from the scope of design protection.[521] The decision further clarified the requirements posed by Article 110(1) CDR, including the dependency of the design of the component part to the appearance of the complex product, and the interpretation of 'use for the purpose of repair'. The question whether a part is dependent on the appearance of the complex product entails a test whether the consumer has some 'realistic choice' in replacing the part, *i.e.* whether the replacement part can be replaced with another part that has a different design. The use for the purpose of repair requires that the parts be normally used for repair, rather

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[516] Design Directive, art 14.
[517] Community Designs Regulation, art 110. From the wording this provision it is unclear whether it qualifies as an exclusion or defence. For purposes of the structure of this work, we deal with this clause under exclusions. However, it should be noted that in the UK, Arnold J held that Article 110(1) operated as a defence, and not an exclusion. *BMW v R&M* [2013] FSR 18 [51].
[518] Joined cases C-397/16 and C-435/16 *Acacia v Audi, and Acacia v Porsche* EU:C:2017:992.
[519] ibid, [54].
[520] *BMW AG v Round & Metal Ltd* [2013] FSR 18 Ch D. (UK). J Cornwell, 'BMW v Round & Metal: First UK Decision on the Community Design "Repair Clause"' (2013) 35(9) EIPR 548.
[521] *BMW v R&M* (n 517) [37].

than an upgrade. In this case, replica wheels were held to normally be used for upgrading the car, rather than to restore it.

3.4.3.3 – United Kingdom – In accordance with the Designs Directive, the RDA excludes three types of designs: (i) designs dictated solely by technical functions; (ii) designs that must necessarily be reproduced in their exact form and dimensions in order to enable them to connect to other products; and (iii) designs that are contrary to morality.[522] The British implementation of Article 14 of the Designs Directive led to the deletion of the previous 'must-match' exclusion, which was, in turn, replaced by an exception to infringement for 'component part which may be used for the purpose of the repair of a complex product so as to restore its original appearance'.[523] The result is that there is no absolute exclusion of must-match features; however, conditional use of such designs would be excluded from liability. The interpretation by Arnold J in *BMW v R&M,*[524] as discussed above, provides guidance as to the possible national interpretation of this provision.[525]

The exceptions for unregistered designs differ. Section 213 of the CDPA contains four exceptions applying to 'surface decoration', 'methods of principles of construction', and features that 'must fit' or 'must-match'. The latter two are of particular relevance to spare parts. The 'must-fit' provision excludes 'all interface features',[526] *i.e.* 'features of shape or configuration of an article which […] enable the article to be connected to, or placed in, around or against, another article so that either article may perform its function'.[527] Analogous to the 'complex repair' provision for registered design, the Act further contains a 'must-match' exception,[528] which excludes designs that 'are *dependent upon* the appearance of another article of which the article is intended by the designer to form an integral part'.[529] In *Dyson v Qualtex,*[530] the Court of Appeals applied a narrow approach and held that

[522] RDA (UK), ss 1C and 1D.
[523] RDA (UK), s 7A (5).
[524] *BMW v R&M* (n 517).
[525] S 7A(5) of the RDA implemented Article 14 of the Directive, which is, in turn, considered to be the same as Article 110(1) Community Designs Regulation.
[526] *Ocular Sciences Ltd v Aspect Vision Care Ltd* [1997] RPC 289, 425.
[527] CDPA, s 213(3)(b)(i).
[528] *Ultraframe UK Ltd v Fielding* [2003] RPC 23, [73]–[74].
[529] CDPA, s 213(3)(b)(ii). Emphasis added.
[530] *Dyson v Qualtex* [2006] RPC 31 CA.

'dependency' must be approached from a practical point of view. Consequently, a spare part will only be excluded if can be shown that 'as a practical matter, there is a real need to copy a feature of shape or configuration because of some design consideration of the whole article'.[531] Hence, spare parts that cannot be substituted without radically affecting the overall appearance of the article will likely be excluded from design protection.

3.4.4 – Reconciling Exceptions with a Decentralised Environment

There is a lack of harmonisation on the international level regarding exceptions to designs infringement, and as a result significant differences remain on the national level. South Africa, for example, does not provide any exceptions to infringement.[532] The situation is, however, different in the EU and UK. The exceptions provided under the Designs Directive and Community Designs Regulation are identical:[533]

- use for private and non-commercial purposes;
- experimental use; and
- use for citation or teaching purposes.

The UK's Registered Designs Act implements the limitations provided by the Designs Directive, while the Intellectual Property Act 2014[534] introduced similar exceptions into the CDPA.[535] Before 2014, however, the sole defence was a special defence in relation to overlap with copyright, in which an infringement of copyright in the design would pre-empt any infringement in the design right.[536]

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[531] ibid, [64].
[532] Section 20(3) of the Designs Act provides for an exception that allows making 'an article embodying the registered design or a design not substantially different from the registered design, for private purposes or for the sole purpose of evaluation, analysis, research or teaching'. However, this exception solely applies to integrated circuits and thus not to any other design right.
[533] Designs Directive, art 13; Community Designs Regulation, art 20.
[534] Intellectual Property Act 2014.
[535] IP Act, s 4; CDPA, s 244A. Section 244A provides: 'Design right is not infringed by—(a) an act which is done privately and for purposes which are not commercial; (b) an act which is done for experimental purposes; or (c) an act of reproduction for teaching purposes or for the purpose of making citations provided that—
(i) the act of reproduction is compatible with fair trade practice and does not unduly prejudice the normal exploitation of the design, and (ii) mention is made of the source.'
[536] CDPA, s 236.

The first exception provides that acts done for private and non-commercial purposes do not infringe the design right.[537] Although not required by international instruments,[538] European legislation contains a double restriction: the acts must be done for non-commercial purposes *and also* be private. In the consumer 3D printing context, the materialisation of designs will likely be for both non-commercial and private purposes; however, a restrictive interpretation of the concept of 'non-commercial' could make public use after production illegal.[539]

The second exception exempts acts done for experimental purposes,[540] and should be interpreted narrowly.[541] It is unclear whether use for experimental *commercial* purposes are covered by this exception[542] and whether the exception is concerned with experiments to the design itself or any type of experiment which uses the protected design.[543]

Third, the European designs regime exempts from protection acts of reproduction for the purpose of making citations or teaching, provided that the source is mentioned, and the act is compatible with fair trade practice and does not unduly prejudice the normal exploitation of the design.[544] It has been argued that teaching should be interpreted broadly and not be limited to educational institutions, either public or private, but include any act connected with teaching.[545] Hence, this exception could, for instance, apply to makerspaces involved in teaching CAD software and 3D printing, or teachers using 3D printed objects to illustrate their lectures. This limitation is subject to mentioning of 'the source', but it remains unclear as to which source should mentioned, *i.e*. the designer, rights holder or manufacturer.[546]

These exceptions do not ask the question whether the source from which the design is created, *i.e.* the CAD model, was lawfully obtained. Some authors argue

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[537] Designs Directive, art 13(1)(a); Community Design Regulation, art 20(1)(a).
[538] Article 26 TRIPS Agreement only requires protection against act for commercial purposes.
[539] Some authors advocate for a broad reading of the commercial requirement. For example, Stone suggests that certain public uses of the item would preclude is from qualifying under the limitation. D Stone, *European Design Law – A Practioner's Guide* (OUP 2012) § 19.43.
[540] Designs Directive, art 13(1)(b); Community Design Regulation, art 20(1)(b).
[541] Suthersanen (n 464) 140.
[542] Bently and Sherman (n 474) 760. *Cf.* Musker (n 432) 391.
[543] ibid. (n 474) 760.
[544] Designs Directive, art 13(1)(c); Community Design Regulation, art 20(1)(c).
[545] Bently and Sherman (n 474) 761.
[546] Scholars advise that all three are mentioned. ibid. 762. Musker (n 432) 390.

that, similar to copyright law,[547] exceptions should only be available when the source is lawfully obtained.[548] While restricting the scope of the exceptions could penalise consumer uses harmful to the right holder, it could have chilling effects on uses for consumer 3D printing. Moreover, enforcement of decentralised infringement remains a significant barrier. In the 3D printing environment, where the CAD is the *sine qua non* for manufacturing, focus again appears to shift to the liability of intermediaries.

It is unlikely, however, that any of the defences apply to the intermediaries concerned, *i.e.* design sharing platforms and providers of 3D printing services, and they should thus exert extreme caution and due diligence before hosting design files and producing on-demand goods.

3.5 – Conclusion

The aim of this Chapter was to explore the application of design rights in the 3D printing environment and the challenges that 3D printing technologies present in this context. It has shown that, generally, designs law tends to favour the predominant 3D printing consumer uses, including repair and personal and non-commercial uses. In the decentralised 3D printing environment, however, the personal and non-commercial use exception could significantly undermine the rights holders' rights and jeopardise their economic interests. The lack of legal recourse against individual infringers brings into focus the role of intermediaries and the possibility to enforce rights based on the digital embodiments of the design. It remains unclear, however, to what extent CAD models can be equated to their physical counterparts, and intermediaries dealing with CAD models are liable for infringement. Equally, there remains uncertainty in the assessment of the scope of designs protection. While it is clear that consumer-based tests for assessing the requirements for registration and infringement of design rights will play a pivotal role in re-delineating the scope of design rights in the context of decentralised creativity, its meaning and scope is less clear. Proposals and recommendations to address these challenges are provided in Chapter Seven.

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[547] Case C-435/12 *ACI Adam BV v Stichting de Thuiskopie* ECLI:EU:2014:254.
[548] Nordberg and Shovsbo (n 472) 295.

Chapter Four
Contextualising 3D Printing within Patent Law

'"tangibility" represents the Achilles heel of modern patent law'[549]

4.1 – Introduction

Patent protection fulfils a dual role within the domain of 3D printing. It covers two distinct categories of subject matter: 3D printable subject matter and 3D printing processes, hardware and materials. Of particular relevance to this thesis is the potential of 3D printing to facilitate the decentralised manufacturing of items that are the subject of patent law. Unlike copyright-based industries, patent-based industries have never faced digitisation, and patent holders will face a new and atypical kind of infringement: individuals who privately manufacture patented goods based on digital dissemination of design files. While the real impact of consumer 3D printing on patent theory is arguably trivial, increased decentralisation has significant implications for patent infringement, and challenges the adequacy of current enforcement tools and strategies.[550]

The focus of this thesis is exclusively on the consumer 3D printing market, and patent claims in this context will typically relate to patented 3D printed objects and their underlying CAD models, rather than to production processes, hardware and materials.[551] This chapter nonetheless discusses the relevant aspects and role of patent law in protecting innovation within 3D printing and enabling consumer access to the

[549] RM Ballardini and M Norrgård, 'Digitising Patent Law: Challenges From 3D Printing Technologies' (2016) 38(8) EIPR 519, 521.
[550] G Van Overwalle and R Leys, '3D Printing and Patent Law: A Disruptive Technology Disrupting Patent Law?' (2017) 48(5) IIC 504.
[551] Intellectual property disputes regarding 3D printing process patents and materials are to rise within the industrial market segment.

technology.[552] While many old patents for 3D printing processes have expired, patents for new techniques are still being issued.[553]

4.1.1 – Patent Law

Patents are concerned with inventions. The notion of 'invention' is primarily formed by prerequisites and exceptions to the patentability.[554] On the international level, the three main instruments are the Paris Convention for the Protection of Intellectual Property, the Patent Cooperation Treaty and the TRIPS Agreement. The Paris Convention grants various rights in relation the patents, particularly reciprocity rights between Member States, while the Patent Cooperation Treaty provides for a single international patent filing system.[555] The main instrument holding substantive law is the TRIPS Agreements which provides, amongst other things, the minimum standards for patent protection and minimum requirements for patentable subject matter.[556]

This said, patent protection remains a matter of national legislation. In South Africa, the Patents Act[557] is modelled on the European Patent Convention,[558] and more particularly the formulation of the British Patents Act of 1977. The lack of guidance from South African authorities in the field of direct and indirect infringement thus requires recourse to the relevant provisions of the laws of the EU and the UK.

The substantive law of patents in the EU remains largely a matter of national legislation.[559] Patent law has nevertheless been subject to significant harmonisation

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[552] In 4.3 – Patents and Accessibility to 3D Printing Technology.
[553] For example, Z Corporation, 'Thermoplastic Powder Material System for Appearance Models from 3D printing Systems' (2004) US Patent 7,569,273; S Das and J J Beaman, 'Directive Selective Laser Sintering of Metals' (2004) US Patent 6,676,892.
[554] D Vaver, 'Invention in Patent Law: A Review and a Modest Proposal' (2003) 11(3) IJLIT 286. The requirements and exceptions to patent protection are discussed later in this section.
[555] Patent Cooperation Treaty of 19 June 1970. The PCT is administered by WIPO. A similar procedure is established by the European Patent Convention, where a single patent application indemnifying various EU Member countries can be filed at the European Patent Office
[556] TRIPS Agreement, art 27.
[557] Patents Act 57 of 1978.
[558] The Convention on the Grant of European Patents of 5 October 1973 <https://www.epo.org/law-practice/legal-texts/html/epc/1973/e/ar52.html> accessed 30 November 2018.
[559] Harmonisation in the field of patent law has only taken place in the field of biotechnology. Directive 98/44/EC of the European Parliament and of the Council of 6 July 1998 on the legal protection of biotechnological invention, [1998] OJ L 213/13.

within the EU, primarily because of the European Patent Convention.[560] The British Patents Act 1977 is modelled on the European Patent Convention and governs the substantial law relating to patents in the United Kingdom.[561] The Convention provides for substantive law for Member States of the European Patent Organisation (EPO), at least in relation to search, examination and grand of patents applications; however, irrespective of a formal obligation to do so, 'cold harmonisation' has taken place.[562] Under the Convention there is the option to obtain a European patent. This is not a unitary right, however, but a collection of independent national patents. The patent requires the applicant to go through the pre-grant procedure only once, and thereafter the European patent can be nationalised to obtain national patents. Recently, after years of dissension,[563] a unitary patent was created.[564] The unitary patent system, however, has yet to enter into force.[565]

The key requirements for patent protection of 'novelty', 'inventive step' and 'capability of industrial application' provide a high bar for protection.[566] To meet the novelty requirement the invention must not 'form part of the state of the art' or be anticipated by such prior art.[567] Typically, the 'state of the art' consists of all matter that has been made public worldwide by written or oral description, by demonstration, by use, or any other way. The requirement of 'inventive step', also known as non-obviousness, requires that the invention is not obvious to a person

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[560] Convention on the Grant of European Patents of 5 October 1973 (European Patent Convention) <https://www.epo.org/law-practice/legal-texts/html/epc/2016/e/index.html> accessed 30 November 2018.

[561] The CDPA contains provisions relating to the establishment of Patents County Courts and amending the Patents Act 1977. CDPA, ss 287-295.

[562] The cumulative effect of the European Patent Convention and the failed Community Patent Convention has caused substantive law to be approximated to a large extent. Kur and Dreier (n 292) 87–88.

[563] Since the inception of EPO in 1973 it has vocalised its desire to establish a single European patent. It should be noted that only 25, thus not all, EU Member States are participating in the unitary patent system.

[564] Regulation 1257/2012 of the European Parliament and the Council of 17 December 2012 on Implementing Enhanced Cooperation in the Area of the Creation of Unitary Patent Protection, [2012] OJ L 361/5; Council Regulation No 1260/2012 of 17 December 2012 implementing enhanced cooperation in the area of the creation of unitary patent protection with regard to the applicable translation arrangements, [2012] OJ L 361/89. The unitary patent differs from the European patent in the post-grant phase where the applicant will now have a single patent that is valid and enforceable in all twenty-six signatory countries.

[565] On the UK's participation in the unitary patent system post-Brexit, see M Lamping and H Ullrich, 'The Impact of Brexit on Unitary Patent Protection and its Court' Max Planck Institute for Innovation & Competition Research Paper No. 18-20 (August 2018) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3232627> accessed 30 November 2018.

[566] At least compared to copyright.

[567] See, for instance, Patents Act (UK), s 2(1).

skilled in the art.[568] For the jurisdictions examined this entails a four-tier test.[569] Ultimately, if a person skilled in the art would have created the same invention when faced with a similar problem, the invention lacks an inventive step. Finally, patent law requires the invention is capable of industrial application, *i.e.* when it can be used or applied in trade, industry or agriculture.[570] These requirements together with the current capabilities of consumer 3D printing technology result in few 3D printable items being eligible for patent protection, and *vice versa*. One exception that is referred to by commentators is the Haberman 'Anywayup Cup' patent that covers a feeder cup for infants.[571]

In order to spur innovation and promote technical progress patent law hinges on a 'bargain' or *quid pro quo*: it provides the patent owner with a temporary exclusive right to exploit the patented invention—generally for a period of 20 years[572]—while at the same time ensuring that the technical knowledge becomes publicly available through disclosure of the technical information concerning the invention. Patents are obtained through registration, including disclosure, with the national or regional[573] intellectual property office. They are subject to a procedural or substantive examination. South Africa currently has a non-examination system, and applications that meet the formal requirements will, in principle, be granted a patent.[574] This approach differs from the UK where the application is subject to both a formal and substantive examination.[575] Initially adopted out of resource restraints, the South African depository system could lead to the patenting of inventions that do not

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[568] Patents Act, s 25(10; Patents Act (UK), s 3; European Patent Convention, art 56.
[569] These four steps/questions comprise of (i) the identification of the notional 'person skilled in the art'; (ii) the identification or construction of the inventive concept of the claim; (iii) the establishment of the differences between the 'state of prior art' and the inventive concept of the claim; and (iv) an evaluation of whether faced with a similar prolem a person with ordinary skill in the art would have created the same invention. The leading South African case is *Ensign Brickford (SA) (Pty) Ltd v AECI Explosives and Chemicals Ltd* 1999 (1) SA 70 (SCA). The UK test is found in *Windsurfing International v Tabor Marine* [1985] RPC 59 (CA).
[570] Patents Act (SA), s 25(1); Patents Act (UK), s 4(1); European Patent Convention, art 57.
[571] UK Patent 2169210. See, Bradshaw, Bowyer and Haufe (n 110) 26; RM Ballardini, M Norrgård and T Minssen, 'Enforcing Patents in the Era of 3D Printing' (2010) 10(11) JIPLP 850. See also *Haberman and Anor v Jackel International* [1999] FSR 683. A more futuristic application could include the home manufacturing of medicines. T Adams, 'The "Chemputer" That Could Print Out Any Drug' *The Guardian* (12 July 2012) <https://www.theguardian.com/science/2012/jul/21/chemputer-that-prints-out-drugs> accessed 30 November 2018.
[572] Article 31 TRIPS Agreement provides for a minimum term of protection of 20 years. Most countries adopted this term of protection.
[573] In case of a single patent grant procedure before the European Patent Office.
[574] Patents Act, s 34 read together with Patent Regulations 1978, rr 40, 41.
[575] Patents Act (UK), ss 17(1), 18(1); Patents Act Rules, rr 28, 29, 31.

deserve such protection.[576] This could arguably hinder the market entry of new innovators and accessibility to certain inventions, including in the field of 3D printing technology development.[577] The recently published 'Intellectual Property Policy' seeks to introduce a substantive search and examination process.[578]

The TRIPS Agreement determines the minimum exclusive rights conferred by a patent.[579] In particular, it requires member states to provide protection against direct infringement, *i.e*. acts immediately engaging with the entirety of the patented invention.[580] Generally, direct infringement involves the making, using, selling, offering to sell and importation of patented objects.[581] The analysis here focusses on the act of 'making', and while few issues have arisen as to what is meant my 'making', there is a grey area between 'making', 'repair' and 'modification' of a product.[582] In relation to the patent of a product, direct liability is absolute, *i.e.* no knowledge of the patent's existence is required on the defendant's side. While not required by the TRIPS Agreement, many jurisdictions have also adopted indirect forms of liability. The most common form of indirect infringement is contributory infringement, which involves some kind of material contribution to the direct infringement.[583]

Unlimited patent protection could lead to oppressive monopolies and undesirable consequences. To prevent such consequences patent law generally provides for exceptions in situations where an activity does not negatively affect a patent's commercial value—particularly when it could increase scientific and

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[576] The patent grant rate in South Africa is very high. See, BN Sampat and K Shadlen, The Effects of Restrictions on Secondary Pharmaceutical Patents: Brazil and India in Comparative Perspective, 17 (2016) <https://economics.harvard.edu/files/economics/files/sampat-bhaven_effects_of_restrictions_on_secondary_pharma_patents_brazil_and_india_3-4-16.pdf> accessed 5 July 2019.

[577] See 4.3 – Patents and Accessibility to 3D Printing Technology.

[578] Department of Trade and Industry, Intellectual Property Policy for the Republic of South Africa: Phase I <https://www.gov.za/sites/default/files/gcis_document/201808/ippolicy2018-phasei.pdf> accessed 5 June 2019. From the Policy it can be inferred that priority will be given to patent applications in the pharmaceutical and other chemistry-based sectors.

[579] TRIPS Agreement, art 28(1).

[580] And its equivalents. This thesis does not go further into the doctrine of equivalents. M Franzosi, 'Equivalent in Europe' (2003) 25(6) EIPR 237. It should further be noted that the protection of a patented 3D printer or printing process extends to the items produced by the use of the process or apparatus. Patents Act, s 67(1).

[581] TRIPS Agreement, art 28(1). Similar language is used in the selected jurisdictions. *Cf*. Patents Act, s 45(1); Patents Act (UK), s 60(1);); Council Agreement on a Unified Patent Court [2013] OJ C 175/1, art 25.

[582] See 4.2.4 – Repair and Modification Defence.

[583] See Patents Act (UK), s 60(2).

technological progress.[584] Indeed, the public interest of patent law of promoting technical progress lies at the core of the patent system. The granting of temporary monopolies on inventions encourages investment in research and development, while the disclosure of the invention increases the public knowledge. Socio-economic conditions and other priorities also influence this balancing of interests between patentees and other parties, such as users, competitors and teaching and research institutions.[585] Exceptions are considered a matter of national legislation—albeit subject to supranational limitations: Similar to the three-step test in copyright law, the TRIPS Agreement allows Members to adopt exceptions

> provided that such exceptions do not unreasonably conflict with a normal exploitation of the patent and do not unreasonably prejudice the legitimate interests of the patent owner, taking account of the legitimate interests of third parties.[586]

On the national level, these exceptions typically take the form of private and non-commercial exceptions, and exceptions for experimental purposes.[587]

4.2 – Digitisation, Decentralisation and Patent Infringement

> Patents will have even more trouble with 3-D copies than copyright law had with digital music sales.[588]

It is apparent that the consumer who 3D prints, *i.e.* 'makes', a patented object is liable for direct patent infringement.[589] Less obvious is the fact that 3D printing services—generally considered intermediaries within the consumer 3D printing environment—risk direct liability by manufacturing and selling patented inventions. Although the printed object was made on behalf of a third party, the printing service is liable for direct infringement as it manufactured and sold the invention. However, as their

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[584] This purpose of patent law was expressed in early British case law. See, for example, *Frearson v Loe* (1878) Ch. D. 48, 66.
[585] Bently and Sherman (n 474) 635.
[586] TRIPS Agreement, art 30.
[587] For Instance, Patents Act (UK), s 60(5)(a)–(b).
[588] T Holbrook, 'How 3-D Printing Threatens Our Patent System' *The Conversation* (6 January 2016) <https://www.scientificamerican.com/article/how-3-d-printing-threatens-our-patent-system> accessed 30 November 2018.
[589] Subject to the application of exceptions.

business model is based on throughput and operational efficiency it might prove economically and practically challenging to verify whether or not an object is patented.[590]

The decentralised nature of the direct infringement—particularly by consumers—makes it difficult to detect, and infringers are geographically dispersed, hard to identify, and above all potential customers.[591] The result is that two alternatives become important in enforcing patents in the digital, decentralised 3D printing environment. These options are discussed in detail below. The first option is *direct* infringement based on the CAD model. It encompasses a theoretical debate considering the lack of enforcement options in the digital environment and the closeness between CAD models are their materialised counterparts. The key question in this context is whether CAD files and the models they embed can be equated to the physical invention. The second alternative primarily analyses the traditional form of enforcement in cases where direct infringement is impractical: the route of *indirect* infringement.[592] Under contributory and vicarious liability, 3D printers and software could be considered the origin of the infringement. There is, however, much uncertainty about the extent to which 3D printing-related actions can be considered as indirect infringement.

The following table demonstrates the uncertainties in patent enforcement under both direct and indirect infringement.

Activity	Actor	Potential Infringement
Creating CAD models, including 3D scanning, modification and remix	User	**Direct:** Use?
Sharing, including the act of copying a file to a folder which is publicly available and uploading a file to a file sharing platform	User Design Sharing Platforms	**Direct:** Use? **Indirect:** Facilitating the materialisation?
Downloading, including downloading CAD models from a hosting website or third party's storage device	User 3D Printing Service	**Direct:** Use?

[590] T Ebrahim, 'Digital Infringement & Digital Regulation' (2016) 14 Nw J Tech & Intell Prop 37, 51.
[591] Individuals might not engage in direct infringement, but merely create and distribute the CAD model of a patented object.
[592] The US Supreme Court has noted that the essential purpose of the contributory infringement doctrine is to "provide for the protection of patent rights where enforcement against direct infringers is impracticable." Aro Manufacturing v Convertible Top Replacement Co., 377 U.S. 476, 511 (1964) (Aro II) (quoting H.R. 5988, 80th Cong., 2d Sess. (1948))

3D Printing, including 3D printing through digital dissemination and streaming	User 3D Printing Service	**Direct:** Making
Streaming	ISP Design Sharing Platform (if cloud distribution)	**Direct:** Use?
Facilitating	ISP Design Sharing Platforms 3D Printing Technology Providers	**Indirect**: Facilitating all off the above-mentioned acts

Figure 5 – Infringement under the Traditional Conception of Patents

4.2.1 – Equating CAD Models to Physical Objects

Patent infringement has historically been linked to physical embodiment of the invention claimed in the patent.[593] Most scholars currently apply the conventional view that digital versions of an object are mere precursors of the physical objects, and the making, using, selling, offering to sell and importation thereof cannot lead to direct infringement.[594] One commentator argues:

> [O]ne cannot "sell" a product that does not yet physically exists in its entirety because any infringement is at that point uncertain or speculative. The sale of a CAD file for use in 3D printing would not be actionable under [the relevant case law] because it is not the actual patented product being sold.[595]

In the same line, others argue that CAD files merely hold information that discloses the invention, and are thus a product of the public domain.[596] However, the patent implications of the digital model have not been subject to judicial examination, and

[593] This requirement has its roots in the industrial age where most innovation relied upon tangible things. However, at least in the US, the sale or offering to sell the invention solely based on diagrams and schematics has been held to lead to infringement. *Transocean Offshore Deepwater Drilling, Inc. v Maersk Contractors USA, Inc*., 617 F.3d 1296, 1310. See also T Holbrook, 'Territoriality and Tangibility after Transocean' (2012) 61 Emory LJ 1081.

[594] See, for example, Bradhaw, Bowyer and Haufe (n 110) 24; DH Brean, 'Asserting Patents to Combat Infringement Via 3D printing: It's No "Use"' (2013) 23 Fordham Intell Prop Media & Ent L J 771, 789–90; Finocchiaro (n 14) 77; SR Peacock, 'Why Manufacturing Matters: 3D Printing, Computer-Aided Designs, and the Rise of End-User Patent Infringement' (2014) 55(5) Wm & Mary L Rev 1933, 1948. Syzdek (n 19) 353; Van Overwalle and Leys (550) 523.

[595] Brean (n 594) 790–92. Relying on *Edocyne Corp. v Croll-Reynolds Engineering Co.*, 491 F. Supp. 194, 197 (D. Conn. 1979) and *Lang v Pacific Marine & Supple Co.,* 895 F.2d 761, 765 (Fed. Cir. 1990).

[596] Peacock (n 594) 1936.

significant uncertainty therefore remains.[597] But applying patent law to CAD files would drastically challenge the traditional way of interpreting patent doctrines. Focusing on the economic interest of the patent holder,[598] Holbrook and Osborn have put forward an argument in favour of 'direct digital patent infringement' and equating intangible CAD files of a patented invention to tangible physical embodiment.[599]

> Our contention is that the interest in CAD files is not the files themselves, but instead the object ultimately produced. Generally, someone does not download a CAD file simply for the purpose of having the file. Instead, the purpose is to produce the object for which the file codes. As a result, some of these freely disseminated CAD files would likely displace some of the patent holder's sales.[600]

CAD files can indeed contain all the information to materialise the invention without much technical knowledge, complexity or time.[601] Moreover, in many instances the digital model and physical 3D printed objects are separated only by a few mouse-clicks. This approach has been criticised, however,[602] and as established in Chapter One, not every design file contains all information needed for the production of a certain product, such as the material and colour.[603] Above all, not all patented objects can be produced with the current 3D printing technologies and the information captured in CAD files. These arguments might need to be reassessed in light of future advancements in the technology.

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[597] In the US patentability of CAD models and 3D printing methods appears particularly challenging in the light of the *Alice* and *Bilski* decisions. *Alice Corp. Pty. Ltd. v. CLS Bank Int'l*, No. 13-298, slip op. at 7-14 (2014); *Bilski v. Kappos*, 561 U.S. 593, 605 (2010).

[598] TR Holbrook and LS Osborn 'Digital Patent Infringement in an Era of 3D printing' (2015) 48(4) UC Davis L Rev 1319, 1358-59. Arguing that the sale of the CAD model could displace the sale of the actual item. Referring to Transocean Offshore Deepwater Drilling, Inc. v Maersk Contractors USA, Inc., 617 F.3d 1296 in which the Federal Circuit found infringement based on the offer to sell documents diagrams and descriptions of the patented invention.

[599] Holbrook and Osborn (n 598) 1367. The authors acknowledge that such an application would raise many additional legal questions.

[600] Holbrook and Osborn (n 598) 1367.

[601] Indeed, unlike detailed photos or a blueprint of a patented item, a CAD does not require to be able to read blueprints, produce the parts and combine them – all these steps are done during the 3D printing process. Ebrahim (n 590) 52.

[602] RM Ballardini, M Norrgård and T Minssen, 'Enforcing Patents in the Era of 3D Printing' (2010) 10(11) JIPLP 850, 856.

[603] The file format determines the type of data that can be captured, including (multiple) colours, materials.

4.2.2 – CAD Models as Enablers of Infringement

Indirect infringement does not turn to the question whether the sharing of a CAD file of a patented invention directly infringes the patent, but whether any actions related to the dealing with such files contributes to, or facilitates, direct infringement. This theory focusses on two categories of potential infringers: (i) user-innovators that provide CAD files through network sharing technologies, and (ii) design sharing platforms that host and distribute design files.

Although this section examines indirect infringement in connection to the act of providing of CAD files, it recognises the role of providers of hardware and software in facilitating infringement. However, as will be shown later in this section, acts that involve facilitating 3D printing by providing generic materials, such as 3D printers, 3D replication technology and printing filament, powders and resins will amount to infringement. Nonetheless, the profits made by hardware manufacturers are proportional to the availability of design files.[604]

There is no statutory basis for contributory infringement in South African law. However, the statute does not exclude common-law liability and action for contributory infringement might therefore be based on common-law delict.[605] In absence of an explicit statutory provisions for contributory infringement, the analysis below is based on the laws of the UK.[606] The 1977 Act introduced general principles for contributory infringement. Accordingly, a person infringes a patent if

> while the patent is in force and without the consent of the proprietor, he *supplies or offers to supply* in the United Kingdom […] *any of the means, relating to an essential element of the invention*, *for putting the invention into effect* when he *knows, or it is obvious to a reasonable person in the circumstances*, that those means are suitable for putting, and are *intended to put, the invention into effect* […].[607]

It is quite clear that uploading of CAD files to on-demand printing services or design sharing platforms by consumers, and the hosting of these models by designs

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[604] The 3D printer hardware manufacturer Makerbot owns the free sharing platform Thingiverse.
[605] Delict holds five core elements of liability: harm, conduct, causation, fault and wrongfulness. This thesis does not analyse the common law of delict in more detail.
[606] US law provides different language; however, the issues are largely the same. § 271(b) 35 U.S.C. See Holbrook and Osborn (n 598) 1342–53.
[607] Patents Act (UK), s 60(2). Italics added. This work focusses on five constitutional elements of indirect infringement.

sharing platforms, would qualify as supplying or offering to supply. At the core, however, is the question whether CAD files qualify as 'means' that relate to 'an essential element' of the invention 'for putting the invention into effect'. There is no statutory definition of 'means' and courts have traditionally interpreted the concept as referring to physical objects, with the exception of computer programmes.[608] Simple and abstract instructions per se do generally not qualify as 'means'; however, there seems to be no apparent objection to extend the concept to CAD files that inherently contain specific and precise instructions to materialise an object.[609] The term 'essential element' should be interpreted together with 'means' and that these means put the invention 'into effect'. While there are different interpretations on the notion of 'essential element', it seems to entail that the element must play a role in producing the 'effect'.[610] For product patents the question turns to whether the means provided, *i.e.* the CAD file, relates to a crucial element of the invention as claimed in the patent claims.[611] It must be noted that CAD files typically only embed geometrical information about the object;[612] and their application thus lies in the manufacturing objects in which the patent claims are achieved by mechanical elements that can be produced using the available additive manufacturing techniques. An example is arguably the Haberman Cup of which the patentable features consist of a mechanical valve system that can be represented digitally in a CAD model and, together with the necessary additional information, captured in the respective design file.[613] This means that CAD files, at least for products of which the patent claims are achieved through mechanical elements, are suitable for 'putting the invention into effect'.

Some scholars support the position that providing CAD files as such amounts to indirect infringement.[614] However, irrespective of whether the CAD file captures all necessary information to manufacture the object, this approach neglects the 3D

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[608] *Agilent Technologies Deutschland GmbH v Waters Corporation* [2004] EWHC 2992 (CH) 36–37; *Menashe Business Mercantile v William Hill Organization* [2003] RPC 31. See also P Johnson, 'Contributing to the Wrong: The Indirect Infringement of Patents' (2010) 5(7) JIPLP 514.
[609] On the distinction between CAD models as computer programmes and mere input data see 5.2.1 – Qualification.
[610] R Miller and others, *Terrell on the Law of Patents* (17th edn, Sweet & Maxwell 2018) Ch 14.
[611] Ballardini, Norrgård and Minssen (n 602) 564.
[612] Some file format allow for the inclusion of additional information, such as material use. However, this entails solely information on the material, not the material itself.
[613] While the Haberman Cupt can undoubtedly be manufactured using 3D printing technology, the extent to which it will achieve the same result remain uncertain. See also (n 571).
[614] See, for example, Ballardini, Norrgård and Minssen (n 602) 862; Mendis (n 18) 161.

printing technology that is imperative to realise the utilitarian function of the object, particularly 3D printing hardware and materials.[615] These elements determine essential characteristics of the printed object and thus whether or not the invention can be put into effect. It is, therefore, submitted that determining 'means' depends on the type and nature of patented object; and will generally include multiple elements, including object-specific CAD files, 3D printing hardware and materials.[616] It can, however, not be ruled out that in a world of ubiquitous 3D printing technology providing files models for a patented object could amount to indirect infringement.

Direct infringement is no precondition for indirect infringement, and patentees can take legal action before their patent has been infringed.[617] However, the Act requires actual or constructive knowledge by the alleged infringer that the means are both suitable and intended to put the invention into effect.[618] In *Grimme Landmaschinenfabrik*[619], the Court of Appeals adopted the 'inherently probable' view, which consist of 'the inquiry being whether the 'means' and the circumstances surrounding it being offered or supplied are such that some ultimate users will intend to use or adapt the 'means' so as to infringe'.[620] However, patent law has traditionally dealt with sophisticated actors familiar with patent law, and difficulties arise in the 3D printing ecosystem where both consumers and design sharing platforms are unfamiliar with patents, and it is difficult for these actors to establish the validity or existence of a patent.

The supply or offering of a 'staple commercial product' does not constitute indirect infringement unless the supply or the offer is made for the purpose of inducing infringement.[621] Although the meaning of a staple commercial product is unclear, it most likely includes basic, readily available and general-purpose elements, such as 3D printers, scanners, software and filament.

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[615] Regardless of whether the CAD file contains information on the materials to be used in the manufacturing process, the actual materials and the relevant 3D printing hardware remain indispendable to produce the output in accordance to the CAD file.
[616] Bradshaw, Bowyer and Haufe (n 110) 27. *Rotocrop v Genbourne* [1982] FSR 241.
[617] *Grimme v Scott* [2010] EWCA Civ 1110; *KCI Licensing v Smith & Nephew* [2010] EWCA 1260. For an overview of cases see Holbrook and Osborn (n 598) 1335, fn 72.
[618] Patents Act (UK), s 60(2).
[619] Grimme (n 617).
[620] ibid, [107].
[621] Patents Act (UK), s 60(3).

4.2.3 – Reconciling Exceptions with a Decentralised Environment

The private and non-commercial activities of consumers have traditionally attracted little attention from patent holders, and their impact within the value chain was negligible. 3D printing challenges the notion that these uses do not pose a threat to the patent monopoly by potentially increasing the amount of private and non-commercial uses to levels that could harm patent owners. The combination of mass decentralised manufacturing and exceptions for private and non-commercial purposes can significantly undermine rights holder interests. This being said, some scholars support the application of a private use exception to protect unknowing consumers from liability where they produce a protected object.[622] Exceptions to experiment with patented inventions, on the other hand, encourage innovators to improve and build upon these patented inventions. Within the 3D printing realm the CAD models of a patented invention could enable follow-on innovation by allowing them to virtually explore ways of improvement and further innovation.

Exceptions for private and non-commercial use, and experimental use are recognised in most common-law jurisdictions.[623] Section 69A of the South African Patents Act contains a so-called *Bolar* exemption under which the non-commercial exploitation of a patent in the process of obtaining regulatory approval does not amount to infringement. While this exemption mostly relates to clinical testing of pharmaceuticals, it could potentially apply to patented 3D printing hardware and materials that are subject to regulatory approval. Apart from this provision, the Patents Act does not contain any exceptions to the rights granted by a patent.[624] In fact, in *Monsanto v Stauffer,*[625] the court confirmed that (general) experimental use was covered by the patent and constitutes an act of infringement.[626] Over time, scholars have argued for the introduction of certain exceptions—until now without

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[622] This is particularly the case in the US where, like South Africa, there is no private use exception in place. D Doherty , 'Downloading Infringement: Patent law as a roadblock to the 3D printing revolution' (2012) 26 Harv JL & Tech 353, 368; Desai and Magliocca (n 1144) 1716.
[623] Title 35 of the USC does not contain any exceptions to the rights conferred in a patent and consumer will be liable even if the invention is copied for personal use. However, courts have periodically applied the principle of *de minimis non curat lex.* For example, *Finney v United States* 188 USPQ 33 (CCTD 1975).
[624] It should be noted, however, that some authors argue that section 45 of the Patent Act applies to the commercial exploitation of an invention only.
[625] 1998 1 SA 805 (T).
[626] ibid, 809.

result.[627] Judicially created defences are equally missing. In contrast to South Africa, the UK excludes private and non-commercial uses of a patent from infringement.[628] The use must be both private, *i.e.* for the person's own use,[629] and non-commercial. The Patents Act also excludes acts done for experimental purposes from infringement.[630] The term includes activities to discover something or test a hypothesis[631] and testing whether the patent works.[632] The question as to whether testing an invention in order to improve it, work around the patent, or develop something falls under the experimental purpose exception remains unanswered.[633]

4.2.4 – Repair and Modification Defence

> [R]epair is one of the concepts (like modifying or adapting) which shares a boundary with "making" but does not trespass on its territory.[634]

Patent law has long recognised the right of purchasers of a patented object to repair and modify it.[635] The owner of a patented device is allowed to repair it to the extent that these repairs do not constitute reconstruction or 'making' of the product.[636] However, the line between permissible repair and prohibited reconstruction is unclear and there is no clear-cut test that consistently delineates the two. This ambiguity may cause tensions between consumers and patent holders;[637] particularly in the 3D printing context where consumers want the freedom to repair and modify products. In fact, various replacement parts are available on design sharing platforms, for a wide range of products and applications.[638]

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[627] See A van der Merwe, 'Experimental Use as a Defence in Patent Infringement Action' (1999) 32 De Jure 138.
[628] Patents Act (UK), s 60(5)(a).
[629] *SKF Laboratories v Evans Medical* [1989] FSR 531, 518.
[630] Patents Act (UK), s 60(5)(b).
[631] *Monsanto v Stauffer* [1985] RPC 515, 542 (CA).
[632] See, for instance, *Micro-Chemicals v Smith Kline and French InterAmerican* (1971) 25 DLR 79, 89; *Monsanto* (n 631).
[633] Bently and Sherman (n 474) 636–37.
[634] *United Wire v Screen Repair Services* [2000] All ER 353 (HL), 358.
[635] See, for instance, *Solar Thomson Engineering v Barton* [1977] RPC 537, 554.
[636] See (UK) *Solar Thomson Engineering v Barton* [1977] RPC 537; *British Leyland v Armstrong* [1986] RPC 279, 376.
[637] C Waelde and others, *Contemporary Intellectual Property* (4ed OUP 2016) 470–74.
[638] See, for instance, Thingiverse, 'Replacement Parts' <https://www.thingiverse.com/explore/newest/household/replacement-parts> accessed 30 November 2018.

The repair and modification doctrine is absent from South African patent law. The UK, however, allows for repair and modification of a patented object as long as not to make the product anew.[639] In *Sirdar Rubber v Wallington Weston,* Justice Swinfen Eady explained this distinction as follows:

> The purchaser of a patented article has a right to prolong its life by fair repair, while the purchaser of a patented item has the right to prolong its life, but he has not any rights to obtain, without licence from the patentee, a substantially new article, made in accordance with the invention, retaining only some subordinate part of the old article, so that it may be said that the combination is not entirely new.[640]

In *Schütz v Werit*[641] the Supreme Court explained that each case must be decided on its own elements[642] and held that the test for determining whether a product was 'made' has to take into account a range of factors, such as the amount of the product repaired, the life expectancy of the part replaced and whether the inventive part of the product has been replaced.[643] It must be noted that case law predominantly involves commercial actors, rather than consumers—the predominant users of repair and modification within the 3D printing environment.

4.3 – Patents and Accessibility to 3D Printing Technology

Innovation in the development of 3D printing technology and materials is driven by a diverse field of both public and private actors, such as universities, private companies, and non-profit organisations. Patents have been playing a key role in protecting early inventors of new manufacturing procedures.[644] They appear to have helped early inventors to get a foothold in the market and in the development of the

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[639] *Solar Thomson Engineering* [1977] RPC 537; *British Leyland v Armstrong* [1986] RPC 279, 376. For a comparative analysis of the repair and reconstruction doctrine in other jurisdictions, see T Dagne and G Piasecka, 'The Right to Repair Doctrine and the Use of 3D Printing Technology in Canadian Patent Law (2016) 14 Can J L & Tech 263.
[640] *Sirdar Rubber v Wallington Westin* [1905] 1 Ch. 451 (Eng. Ch. Div.), 453–54.
[641] *Schütz v Werit* [2013] UKSC 16.
[642] ibid., [58].
[643] ibid., [60]–[71].
[644] In 2013, a study issued by the UK IPO identified over 9000 patents related to 3D printing technology. UK IPO, '3D printing: A Patent Overview' (November 2013), 10 <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/445232/3D_Printing_Report.pdf> accessed 30 November 2018.

industry;[645] however, at the same time patents have been used to prevent competitors from developing consumer level printers—indirectly making consumer 3D printing hardware less accessible.[646] The following sections discuss two appropriability regimes in relation to 3D printing hardware: proprietary hardware and processes (4.3.1) and open source initiatives (4.3.2).

4.3.1 – Proprietary Hardware and Processes

Since the year 2000, there has been a significant rise in global 3D printing-related patent applications.[647] The US is the leader in issuing 3D printing patents, followed by Japan, WIPO and China.[648] Patents generally cover 3D printer hardware, components, and manufacturing processes. Raw materials are typically considered to be general purpose materials, but at least in some cases they might be covered by patents.[649]

Patenting of 3D printing technology directly impacts the development and accessibility of consumer 3D printing. Anecdotal evidence shows that the expiry of several key patent on 3D printing technology has had a remarkable impact on the market entry of consumer 3D printers.[650] The expiry of 'Fused Deposition Modeling' patents in 2009, for example, led to the development of open-source projects, such as

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[645] Stratasys and 3D Systems were early movers within the 3D printing market and hold the top patent applications for AM technology. WIPO (n 28) 99–104; Bradshaw, Bowyer and Haufe (n 110) 7–8.

[646] In 2012, when Formlabs launched their Kickstarter campaign for an affordable SLA printer, it was sued by 3D systems. The matter was settled in December 2014 after which Formlabs now pays an 8% royalty to 3D systems for every product sold. J Biggs, '3D Systems v. Formlabs Patent Lawsuit Dismissed' (*TechCrunch*, 1 December 2014) <https://techcrunch.com/2014/12/01/3d-systems-v-form-labs-patent-lawsuit-dismissed/> accessed 30 November 2018. In 2016, Formlabs was sued again over patent claims on its 3D printing technology. C Woodward, 'Formlabs Faces Another Patent Battle Over 3-D Printers' *Boston Globe* (12 September 2016) <https://www.bostonglobe.com/business/2016/09/12/formlabs-faces-another-patent-battle-over-printers/0f4wqLw6p27p55VrJKjyXL/story.html> accessed 30 November 2018.

[647] UK IPO (n 644) 12.

[648] ibid, 13.

[649] Many materials have been used in the industry for year and lack novelty. However, new printing materials could qualify for patent protection. It must be noted that there is a significant gap in the legal research on 3D printing materials and patents.

[650] See Wohlers Associates, 'Wohlers Report 2014: 3D Printing and Additive Manufacturing State of the Industry' (Wohlers, 2014), 14 <https://www.wohlersassocioates.com/2014report.htm> accessed 30 November 2018; Bechtold (n 43). See also F Schoffer, 'How Expiring Patents Are Ushering in the Next Generation of 3D Printing' (*TechCrunch*, 15 May 2016) <http://techcrunch.com/2016/05/15/how-expiring-patents-are-ushering-in-the-next-generation-of-3d-printing/> accessed 30 November 2018.

the RepRap, and 3D printer manufacturers paved the way for affordable and user-friendly extrusion 3D printers.

It is expected that the expiry of other key patents[651] will ignite an innovation boost within, for instance, liquid-based (SLA), powder-based (SLS) and metal-based (DMLS) printing processes, making the technologies available to the consumer market.[652] At the same time patents for new techniques keep being issued.[653] While this is not problematic as such, many applications are filed that are regarded as 'both overly-broad and dangerous to the free and open source community'.[654] This could be detrimental for development and use of 3D printing technology and the enforcement of hardware related patents could lead to chilling effects on the development of new 3D printing hardware and technologies.[655]

4.3.2 – Open Source Initiatives

Open source 3D printers play an integral role in the consumer 3D printing ecosystem. The rise of consumer 3D printers is in parts attributable to the emergence of various open source initiatives, particularly in the field of hardware development.[656] Apart

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[651] For an overview see J Hornick and D Roland, 'Many 3D Printing Patents Are Expiring Soon: Here's A Round Up & Overview of Them' (3DPrinting Industry, 29 December 2013) <https://3dprintingindustry.com/news/many-3d-printing-patents-expiring-soon-heres-round-overview-21708> accessed 30 November 2018; J Hornick and A Bhushan, 'More 3D Printing Patents Are Expiring Soon: Here's a Roundup' (*3DPrinting Industry*, 3 October 2016) <https://3dprintingindustry.com/news/more-3d-printing-patents-are-expiring-soon-heres-a-roundup-96561> accessed 30 November 2018.

[652] PriceWaterhouseCoopers, 'The Future of 3-D Printing: Moving Beyond Prototyping to Finished Products, Technologyforecast' (Issue 2, 2014), 5 <https://www.pwc.com/us/en/technology-forecast/2014/3d-printing/features/assets/pwc-3d-printing-full-series.pdf> accessed 30 November 2018. In 2017, SLA printers, such as the Formlabs Form 2, are available in the 3000-4000 USD range. T Hoffman, 'The Best 3D Printers of 2016' (*PCMag*, 18 January 2017) <https://www.pcmag.com/article2/0,2817,2470038,00.asp> accessed 30 November 2018. See also W Gao and others, 'The Status, Challenges, and Future of Additive Manufacturing in Engineering' (2015) 69 Computer-Aided Design 65.

[653] UK IPO (n 644) 12.

[654] J Samuels, 'We Need Your Help! Join Our Fight to Keep 3D Printing Open' (*Electronic Frontier Foundation*, 14 December 2012) <https://www.eff.org/deeplinks/2012/12/we-need-your-help-join-our-fight-keep-3d-printing-open> accessed 30 November 2018.

[655] Anecdotal evidence showe that some patents are beig enforced. Tzu and Hsin-Ning provide a list of patents that have been litigated. However, this list is likely to be incomplete. C Yen-Tzu and S Hsin-Ning, 'Understanding Patent Portfolio and Development Strategy of 3D Printing Technology', Portland International Conference on Management of Engineering & Technology (PICMET) Proceedings (2014) 1407–15.

[656] Wohlers Associates, R Tech, J-P Ferdinand and M Dopfer, 'Open Source Hardware Startups and Their Communities – The Case of Desktop 3D Printing' in J P Ferdinand, U Petschow and S Dicket (eds), The Decentralized and Networked Future of Value Creation (Springer 2016) 129–46.

from these hardware initiatives, the open source community has also facilitated the creation and development of 3D printing software.[657] The key incentives for the development of open source hardware and software—and this would include open source 3D printing hardware—are personal needs and reputational goals.[658]

The most well-known open source 3D printer is the RepRap, which stands for Replicating Rapid-prototyper. It is a self-replicating extrusion 3D printer machine to the extent that it is able to manufacture most of its own components.[659] The RepRap gained popularity in communities of researchers, hobbyist and hackers alike. The designs to the machine were made available for free online under a GNU General Public License.[660] The open source character of these printers generally provides free access to the underlying blueprints, combined with the permission for third parties to freely use and adapt the design. Currently, there are over 60 different RepRap designs available online for free, under a variety of open source licences.[661]

4.4 – Conclusion

The purpose of this chapter has been to discuss the key issues patent holders will be facing in the context of digital distribution-based decentralised manufacturing, and establish the extent to which patent law plays a role in making 3D printing technology available to consumers. The impact of 3D printing on patent industries is negligible; however, rights holders relying on patents of objects that can be 3D printed will battle with this new environment. Where traditionally infringers would be large companies, patent owners are now increasingly confronted with laypeople as infringers, facilitators and inducers. Considering this new dynamic, this chapter has shown that 3D printing questions the appropriateness of the current patent framework, and exaggerates enforceability issues related to digitisation and

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[657] For instance, Slic3R and Cura.
[658] J de Jong and E de Bruijn, 'Innovation Lessons from 3-D Printing' (2013) 54(2) MIT Sloan Management Review 43, 45; Bechtold (n 43).
[659] Sells E and others, 'RepRap: The Replicating Rapid Prototyper – Maximizing Customizability by Breeding the Means of Production' in Frank T Piller and Mitchell M Tseng *Handbook of Research in Mass Customization and Personalization*, vol 1 (World Scientific Publishing 2009) 568-580.
[660] <https://www.reprap.org> accessed 30 November 2018. See generally A Bowyer, 'The Self-Replicating 3D printer – Manufacturing for the Masses' in David M Jacobson, Christ E Bocking and Allan Rennie (eds), *Eight National Conference on Rapid Designs, Prototyping and Manufacture* (Centre for Rapid Design and Manufacture, Buckinghamshire Chilterns University College, High Wycombe, Bucks 2007). See also 6.3.2.2 – GNU.
[661] RepRap <http://reprap.org/wiki/RepRap_Options> accessed 30 November 2018.

decentralisation. This is because infringement in the physical environment is decentralised, difficult to detect and likely excluded under the private and non-commercial exception. The digital environment, in turn, poses uncertainty and legal barriers in enforcing rights against both users and intermediaries, and the theories of direct and indirect liability are unlikely to succeed. 3D printing nevertheless promotes the public interest and increasingly enables consumers to repair products. The extent to which 3D printing will actually enable such uses depends on how patent law responds to digitisation and decentralisation.

Chapter Five
The Pivotal Role of Copyright Law within 3D Printing

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Digital technologies are based on copying, so copyright becomes their regulator: a role it was never designed to perform.[662]

5.1 – Introduction

Technological change has left its mark on copyright.[663] The introduction of new technologies, from the printing press to digital music, books and films, have all affected the development of copyright law.[664] Digitisation and digital piracy is thus not new to copyright; however, through the combination of decentralised design creation and democratised manufacturing 3D printing brings digitisation and copyright to the world of physical items. The ongoing debate on the scope of liabilities of intermediaries,[665] which can be applied to design file sharing, combined with new copyright issues relating to the qualification and scope of protection for

[662] I Hargreaves, 'Digital Opportunity: A Review of Intellectual Property and Growth' (2011) <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32563/ipreview-finalreport.pdf> accessed 30 November 2018.
[663] See Jones (n 2); Litman (n 2); Laing (n 2); Stokes (n 2); Committee on Intellectual Property Rights, Computer Science & Telecommunications Board (n 2); Efroni (n 2).
[664] See P Goldstein, *Copyright's Highway: From Gutenberg to the Celestial Jukebox* (Stanford University Press 1994).
[665] H Larusson, 'Uncertainty in the Scope of Copyright: the Case of Illegal File Sharing in the UK' (2009) 31(3) EIPR 124. C Nasir 'Taming the Beast of File-sharing - Legal and Technological Solutions to the Problem of Copyright Infringement over the Internet: Part 1' (2005) 16(3) Ent L Rev 50; C Nasir, 'Taming the Beast of File-sharing - Legal and Technological Solutions to the Problem of Copyright Infringement over the Internet: Part 2' (2005) 16(4) Ent L Rev 60. More recent, see the case law on 'communication to the public'. For instance, Case C-466/12 *Svensson v Retriever Sverige AB* EU:C:2014:76, [2014] Bus L R 259; Case C-117/15 *Reha Training v GEMA* EU:C:2016:379; Case C-160/15 *GS Media BV v Sanoma Media Netherlands BV* EU:C:2016:644, [2016] Bus L R 1231; Case C-527/15 *Stichting Brein v Wullems (t/a Filmspeler)* EU:C:2017:300, [2017] ECDR 14; Case C-610/15 *Stichting Brein v Ziggo BV and XS4All Internet BV* EU:C:2017:456.

CAD models, make the 3D printing environment a precarious arena for users,[666] rights holders[667] and facilitators.[668] Liability primarily arises from the unauthorised reproduction and communication to the public[669] of the work, and infringement of the moral rights of integrity and paternity of the author. Apart from these acts of primary infringement, accessorial infringement can arise when aiding and abetting primary infringement—so-called secondary infringement.[670]

3D printing potentially concerns the following copyright works:[671]

- Preliminary works (such as sketches);[672]
- CAD models;
- 3D printed objects;
- Print files.

This chapter examines the relationship between copyright and 3D printing. It discusses issues regarding subsistence of copyright in digital and physical designs, including qualification, originality and authorship and ownership in the collaborative environment. This chapter also addresses questions concerning the liability of the different actors involved in 3D printing, including the right to reproduction, adaptation, and communication to the public (including making available and distribution). Finally, the chapter examines the overlap in protection between copyright and the law of designs and patents.

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[666] This term primarily describes the person who uploads or otherwise makes available design files, downloads, modifies, customises and materialised digital models. It should be noted that the person who uses a digital model, often engages in acts of modification, customisation and follow-on creation, and, in turn, becomes a rights holder. See also 1.2.2 – Actors.

[667] This term includes persons who have copyright in any of the 3D printing copyright works. In many occasions, as noted above, this also includes users.

[668] This term generally describes the various actors that are involved in enabling user access to digital models and otherwise providing means to facilitate the 3D printing process. It includes software- and hardware providers, design sharing platforms, (on-demand) 3D printing services and internet service providers.

[669] Including making available right and right of distribution.

[670] Bently and Sherman (n 474) 217.

[671] To the extent these works qualify under copyright protection see 5.2 – Subsistence of Copyright, and 5.2.1 – Qualification.

[672] This work will not further discuss upstream creation. It should, however, be noted that preliminary works do not imperil originality in the final work. *Biotrading and Financing OY v Biohit Ltd* [1996] FSR 393.

5.1.1 – Copyright

> In broad terms, copyright may be described as the exclusive right in relation to work embodying intellectual content to do or to authorise other to do certain acts in relation to that work.[673]

A copyright owner has exclusive economic and moral rights, and any unauthorised exploitation of these rights amounts, in principle, to copyright infringement.[674] The economic rights subsist for an extensive period depending on the type of work at issue—generally for the lifetime of the author plus 50 to 70 years.[675] The exclusive economic and moral rights relevant to this thesis are discussed later.[676]

Authorship is a cornerstone of copyright. The author is typically the person who makes or creates the work,[677] and many of the rules and concepts in copyright law refer to authorship.[678] Principally being the (initial) copyright owner, the author often also exercises the economic rights that subsist in that work.[679]

Various international instruments have largely harmonised the laws of copyright on the national level.[680] The result is that in most jurisdictions copyright subsists without formalities upon the creation of a work that fulfils the copyright requirements. These core requirements are the same in the jurisdictions examined, and copyright typically subsists in 'original' 'works' that have been 'reduced to material form'.[681] However, there remain differences in the interpretation and application of these requirements on the national level. Before outlining these

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[673] *Handbook of South African Copyright Law* (service 15, 2015) 1-1.
[674] 5.3 – Digitisation, Decentralisation and Copyright Infringement.
[675] The minimum term of protection for most works provided by the TRIPS Agreement is lifetime of the author plus 50 years from the end of the calendar year in which the author dies. TRIPS Agreement, art 12. On the national level see, for instance, Copyright Act, s 3(2)(a); CDPA, s 12(2).
[676] 5.1.2 – Rights Conferred by Copyright
[677] At least for literary, musical and artistic works. See Copyright Act, s 1, definition of 'author'. See also CDPA, s 9(1).
[678] For instance, the term of copyright protection is generally calculated *post mortem auctoris*. Copyright Act, s 3(2)(a).
[679] See Copyright Act, s21(1)(a); CDPA, s 11(1).
[680] Primarily the Berne Convention, TRIPS Agreement and the WIPO internet treaties. The impact of these agreements is addressed in the following analysis of the requirements for subsistence and infringement.
[681] In addition, it is sometimes required the work is made by a 'qualified person'. See Copyright Act, ss 3(1) and 37; CDPA, s 206.

requirements, the national and regional legal framework of the jurisdictions examined is briefly outlined below.

The Copyright Act 98 of 1978 together with the Copyright Regulations[682] govern copyright law in South Africa. Although the Act has been amended several times, it is now seen as out-dated and inadequate for the digital age.[683] On 25 July 2015, the Department for Trade and Industry put forward the first version of the draft Copyright Amendment Bill,[684] which is intended to modernise the current copyright Act. To this date, the final version of the Bill is still going through the legislative process.[685]

In the EU, copyright largely remains a product of national law, but various copyright Directives have helped to further harmonise copyright law in the region.[686] Most important Directives for the current analysis is the InfoSoc Directive[687] which harmonises the reproduction right, right of communication to the public of works, and the right of making works available to the public, the distribution right, and limitations and exceptions to these exclusive rights.[688] However, many major copyright issues, such as the threshold for originality[689] and moral rights, remain unregulated. Despite partial harmonisation on the legislative level, the CJEU has started harmonising the EU standard of originality.[690] In *Infopaq*[691] and *Bezpečnostní softwarová asociace*[692] the Court adopted the continental 'the author's own

[682] Copyright Regulations 1978.
[683] For example, the current Copyright Act does it does not sufficiently take into account new, digital technologies.
[684] Government Gazette no. 39028 of 27 July 2015.
[685] The fourth, and latest version of the Bill has been presented by the Portfolio Committee on Trade and Industry. <https://libguides.wits.ac.za/ld.php?content_id=45613747> accessed 10 December 3018. This version was passed by the National Assembly on 5 December 2018, and will now be considered by the National Council of Provinces, before it is returned to the National Assembly to rectify any changes and being signed into law by the President.
[686] For an overview see Bently and Sherman (474) 46–55. These Directives are implemented on a national level. At the time of writing, the Directive on Copyright in the Digital Single Market Directive was in the drafting stage.
[687] Directive 2001/29/EC of the European Parliament and of the Council of 22 May 2001 on the harmonisation of certain aspects of copyright and related rights in the information society.
[688] For all works and, to a large extent, for performers, phonogram and film producers and broadcasting organisations.
[689] Apart from the originality standard for computer programs, databases and photographic works.
[690] E Rosati, *Originality in EU Copyright: Full Harmonization through Case Law* (Edward Elgar 2013).
[691] Case C-5/08 *Infopaq International A/S v Danske Dagblades Forening* [2009] ECR I-6569.
[692] Case C-393/09 *Bezpečnostní softwarová asociace –Svaz softwarové ochrany v Ministerstvo kultury* [2010] I-13971.

intellectual creation' threshold for originality.[693] Various later decisions have further developed and clarified this standard.[694] On the national level, the Copyright, Design and Patents Act (CDPA), as amended,[695] governs copyright in the United Kingdom. Considering the maturity and leading role of US copyright law this chapter will also analyse the legal *status quo* in the US, in particular under the Copyright Act of 1976. In 1998 Congress amended the Copyright Act of 1976 by implementing the Digital Millennium Copyright Act (DMCA), which introduced, amongst other things, 'safe harbour' provisions for OSPs.[696]

5.1.1.1 – A 'Work' – Each jurisdiction provides a list of classes or categories of works that are eligible for copyright protection. South Africa and the UK apply a 'closed list' approach, and copyright only applies to works that qualify as such within the enumerated classes or categories of works.[697] The most profound benefit of an exhaustive qualification is that copyright is not inappropriately extended to subject matter that does not deserve protection.[698] This said, in the light of the *Infopaq*[699] decision it appears that, at least for the UK, everything that is the result of intellectual creation should obtain copyright protection regardless of categorisation.[700] The US,

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[693] For subject matter other than computer programs, databases and photographic works.
[694] Joined cases C-403/08, C-429/08 *Football Association Premier League Ltd (FAPL) v QC Leisure and Karen Murphy v Media Protection Services* [2011] ECR I-9083; Case C-145/10 *Eva-Maria Painer v Standard VerlagsGmbH* [2011] ECR I-12533; Case C-604/10 *Football Dataco v Yahoo!* EU:C:2012:115; Case C- 406/10 *SAS Institute v World Programming* [2012] EU:C:2012:259.
[695] By the Copyright and Related Rights Regulations 2003.
[696] 17 U.S.C.A. § 512.
[697] Generally, these classes and categories of works are exhaustive, while the sub classifications or categories are non-exhaustive.
[698] T Aplin, 'Subject Matter' in Estelle Derclaye (ed*), Research Handbook on the Future of EU Copyright* (Edward Elgar 2009) 47; RA Reese, 'What Should Copyright Protect?' in Rebecca Giblin and Kimberlee Weatherall (eds), *What If We Could Reimagine Copyright?* (Australian National University Press 2017) 111. In the US, which applies an 'open list 'approach, there has been an increased interest in the scope of copyright for utilitarian items within 3D printing, particularly in the anticipation of the Supreme Court's Decision in Start Athletica. Star Athletica L.L.C. v Varsity Brands, Inc., 580 U.S. ___, 197 L. Ed 2d 354 (2017). Various 3D printing stakeholders, including hardware manufacturers and design sharing platforms, advocated for a clear test on copyright for functional objects. Public Knowledge and others, Amici Curiae in support of petitioner <https://www.publicknowledge.org/assets/uploads/documents/brief-star-athletica-merits.pdf> accessed 30 November 2018; Formlabs and others, Amici Curiae in support of petitioner <https://www.scotusblog.com/wp-content/uploads/2016/03/Star-Athletica-v-Varsity-Brands-Amicus-of-Shapeways-FILED.pdf> accessed 30 November 2018.
[699] Case C-5/08 *Infopaq International A/S v Danske Dagblades Forening* [2009] ECR I-6569.
[700] In the light of the Infopaq decision, Apil and Davis note that recent CJEU case law indicates that categorisation of a particular work is not necessary when there is an intellectual creation. J Aplin and T F Davis, *Intellectual Property Law – Text, Cases, and Materials* (3rd edn, OUP 2017) 76-107. See also E Rosati, 'Closed Subject-matter Systems Are No Longer Compatible with EU Copyright' (2014) GRUR Int 1112.

on the other hand, applies the 'open list' approach which broadly defines subject matter of copyright protection and generally provides a non-exhaustive list of eligible subject matter. [701]

The qualification of a work has direct implications for authorship, ownership, duration and scope of protection of the work,[702] including the applicability of moral rights.[703] In the context of 3D printing, it is crucial to consider that the qualification of works will determine the extent to which copyright in the CAD model can be used as a protection tool for subject matter that is normally excluded from its protection, including utilitarian items.[704]

5.1.1.2 – 'Originality' – Originality is the most fundamental requirement for copyright protection, and indicates some kind of personal involvement or creativity in the creation of a work. The meaning of originality is not defined in international instruments such as the Berne Convention,[705] and as a result, countries require different levels of originality on a national level. This could lead to different outcomes in relation to the protection of CAD models. The pre-requisite of originality in the context of digital models is discussed later in more detail.[706]

5.1.1.3 – Reduction to Material Form (including the Idea/Expression Dichotomy) – The long-established principle that copyright protects expressions, and not ideas, is found in TRIPS[707] and the WCT.[708] The idea/expression dichotomy prevents ideas from being taken out of the public domain, because to do so would stifle further creativity and research.[709] This principle aligns with the requirements that works be reduced to material form. However, the boundaries between ideas and

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[701] 17 USC §102. See also, French Intellectual Property Code 1992, L112-1.
[702] Particularly the test for substantial similarity. See 5.3.1 – Direct Infringement.
[703] Moral rights do generally not extend to computer programs. See, for example, CDPA, s 81(2).
[704] See 5.4.1 – Copyright-Design.
[705] The term originality is derived from the notion of 'productions' and is inherent in the notion of 'literary and artistic works'. Berne Convention, art 2(1).
[706] See 5.2.2 – Originality.
[707] TRIPS Agreement, art 9(2).
[708] WCT, art 2.
[709] J Rubin, 'Television Formats: Caught in the Abyss of the Idea/expression Dichotomy' (2005) 16(2) Fordham Intell Prop Media & Ent LJ 663, 675.

their expression are often difficult to establish.[710] The issues in relation to 3D printing are analysed later.[711]

5.1.2 – Rights Conferred by Copyright

5.1.2.1 – The Reproduction Right – The right to reproduce is at the core of copyright law.[712] Traditionally regarded as the right to 'copy',[713] it is nowadays defined as exclusive right 'to reproduce the work in a material form'.[714] On the international level the right of reproduction is required by the Berne Convention,[715] WCT,[716] WPPT[717] and the TRIPS Agreement.[718]

In the physical environment, the use of an item does not amount to reproduction; however, the mere use of digital works inevitably involves the making of copies, albeit often temporarily.[719] The result is that reproduction is ubiquitous in the digital world as it encompasses temporary, transient, and incidental copying.[720] It is nonetheless held that the reproduction right fully applies in the digital environment and covers both digital and temporary fixations.[721] When dealing with digital design files, reproduction will take place when the file is downloaded or used on a

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[710] D Bainbridge, *Intellectual Property* (8th edn, Pearson 2010) 49.
[711] In 5.2.3 – The Idea/Expression Dichotomy and Merger.
[712] Ricketson describes the right of reproduction as 'undoubtedly the most fundamental rights which has been accorded historically to authors under national legislation. S Ricketson, *The Berne Convention for the Protection of Literary and Artistic Works: 1886-1986* (Kluwer 1987) §8.6. On the European level, the Advocate General uses the term 'fundamental' to describe the author's right of reproduction. Joined Cases C-457/11, C-458/11, C-459/11 *VG Wort v KYOCERA Document Solutions Deutschland GmbH* (AG Opinion, 24 January 2013) EU:2013:34, [AG33].
[713] The Statute of Anne, which is regarded as the first statute that provided copyright protection, granted rights to print (*i.e.* make copies of) books. The terminology 'copy' and 'copying' can still be found in most common-law copyright legislation.
[714] So far as it concerns literary, dramatic, musical and artistic works. In the UK, this terminology was originally introduced in the Copyright Act 1911. See also, CDPA, s 17(2); Copyright Act No 63 of 1968, s 31(1)(a)(i).
[715] Berne Convention, art 9(1).
[716] WCT, art 1(4).
[717] WPPT, arts 7 and 11.
[718] TRIPS Agreement, art 9(1).
[719] Efroni (n 2) 203–10.
[720] For instance, InfoSoc Directive, art 2.
[721] The agreed statements to the WCT and WPPT provide that the right of reproduction 'fully apply in the digital environment, in particular to the use of works in digital form.' WPPT, agreed statement concerning Articles 7, 11 and 16; WCT, agreed statement concerning Article 1(4).

computer.[722] Notably, in the digital age, reproduction often happens without considering the legality of the act.

5.1.2.2 – The Adaptation Right – Adaptation occurs when one or more existing works are manipulated without creating a second object that could be considered a reproduction of any of the pre-existing works.[723] The right to make an adaptation generally includes dramatisations and translations; however, national laws frequently regard these actions as a form of reproduction.[724] Considering the unclear division between the adaptation and reproduction right, the two are often applied simultaneously. In fact, the British provision dealing with the right of adaptation suggests that this right is closely related to the right of reproduction:

> No inference shall be drawn from this section as to what does or does not amount to copying a work.[725]

5.1.2.3 – The Distribution Right – The distribution right covers the act of issuing each and every copy of the work to the public, including the original.[726] This right is exhausted[727] once a copy has been lawfully put into commercial circulation in a certain jurisdiction.[728] Neither the Berne Convention, nor the Rome Convention provide a general right of distribution.[729] However, the right is contained in the WCT[730] and several European Directives.[731] Although the right appears to apply to

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[722] In South African copyright law, the term is interpreted broadly to include temporary or permanent electronic copies of works. See, for example, *Pastel Software (Pty) Ltd v Pink Software (Pty) Ltd* (1991) 399 JOC (T). In this case, it was held that the temporary and transient electronic reproduction of a work on a computer screen constituted copyright infringement.
[723] RE Schechter and JR Thomas, *Principles of Copyright Law* (Thompson Reuters 2010) 214.
[724] See, for example, France. Art L 122-1 of the French Intellectual Property Code states that the author's rights cover reproduction and performance. However, the definition of reproduction in art L 122-3 of the Code is broad enough to cover adaptations. See also S Ricketson and JC Ginsburg, *International Copyright and Neighbouring Rights: the Berne Convention and Beyond,* vol 1 (2nd edn, OUP 2006) 11.28.
[725] CDPA, s 21(5).
[726] For example, InfoSoc Directive, recital 28; WCT, art 6(1); CDPA, s 18.
[727] The distribution right applies to the first distribution of the copy.
[728] Exhaustion is generally national. See, for example, in the US, §109(a) 17 USC. In the EU, exhaustion occurs when a work has been issues to the public in one of the Member States. Copyright Directive, art 4(2).
[729] See Ricketson and Ginsburg (n 724) 11.45
[730] WCT, art 6(1).
[731] For instance, Copyright Directive, art 4(1); InfoSoc Directive, art 4.

the transfer of a tangible copies,[732] it has been suggested that, at least for computer programmes, it comprises the restricted act of communication to the public.[733] Ultimately, it is a matter of national jurisdiction whether dissemination of files of the internet constitutes distribution.[734]

5.1.2.4 – The Communication to the Public Right – This 'family'[735] of rights recognises a broad set of communications:[736] the right to broadcast the work,[737] communicate it, and make it available to the public. Although these rights were only recognised around the new Millennium,[738] the Berne Convention[739] and national legislation already recognised some elements of these general rights.[740] Communication to the public lacks a general definition. On the European level, the *InfoSoc Directive* merely provides that

> Member States shall provide authors the exclusive right to authorise or prohibit any communication to the public of their works, by wire or wireless means, including the making available to the public of their works in such a way that members of the public may access them from a place and at a time individually chosen by them.[741]

Increased file sharing, through different means,[742] has created a clear need for clarification on the scope and application of the communication to the public right.[743]

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[732] The issuing of a digital copy does, in principle, consist of making another copy. In the EU, see recital 28 and 29 of the InfoSoc Directive. See also Case C-419/13 *Art & Allposters International BV v Stichting Pictoright* EU:C:2015:27 [40].
[733] At least in in the EU. T Cook, *EU Intellectual Property Law* (2010 UOP) 3.118. This interpretation is supported by the language of Art 4(1)(c) of the Computer Program Directive: '*any form* of distribution to the public, including the rental, of the original computer program or of copies thereof.' (emphasis added). Directive 2009/24/EC of the European Parliament and of the Council of 23 April 2009 on the legal protection of computer programs [2009] OJ L 111/16.
[734] See also footnote 883.
[735] The rights have some common features. See Bently and Sherman (n 474) 159. Referring, amongst others, to *ITV Studios Ltd v TV Catch Up Ltd* [2010] EWHC 3063 (Ch). See also J Reinbothe and S von Lewinski, *The WIPO Treaties 1996* (Bloomsbury 2001) 108
[736] While in the analog world communication was generally limited to broadcasting, the rise digital communications required the recognition of a broader set of rights.
[737] The right to broadcast the work is not further discussed in this work.
[738] With the WIPO treaties of 1996 on the international level and the InfoSoc Directive of 2001 on the European Level. M Walter, 'Article 3 Right of Communication to the Public of Works and Right of Making Available to the Public of Other Subject Matter' in Michel Walter and Silke von Lewinski (eds), *European Copyright Law – A Commentary* (OUP 2010) 975-980.
[739] Berne Convention, art 11bis.
[740] In the UK, for example, this right came in place of the broadcasting right and the cable programming right, which had been recognised respectively since 1954 and 1984.
[741] InfoSoc Directive, Art 3(1).
[742] For example, files are uploaded to websites; files stored on a computer are made accessible to others (including Peer-to-Peer networks), and files are indexed and hyperlinks are created.

Over the last years a rich body of case law by the CJEU has further developed the scope and application of the communication to the public right;[744] however, much uncertainty remains.[745]

5.1.2.5 – Moral Rights – The expression of an author's personality in his work is protected through moral rights. The unauthorised adaptation, and to some extent sharing, of CAD models may infringe on the author's moral rights, particularly the right of attribution and integrity.[746] In some civil law countries, for example under France's *droit moral*, the right of dissemination is protected as a moral right and sharing of an unpublished work infringes thereupon.

This thesis primarily focusses on economic rights.

5.1.3 – Limitations, Exceptions and Defences

Copyright laws seek to strike a balance between the owner's monopoly rights on the one hand, and the public interest in having equitable access to works on the other. One key tool for safeguarding the public interest are so-called limitations and exceptions, sometimes—controversially—referred to as 'user rights'.[747] Limitations and exceptions are considered a matter of national legislation; however, they are subject to the 'three-step' test'.[748]

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[743] For instance, to what extent linking to infringing connect constitutes communication to the public.
[744] There have been over twenty cases. See infra note 889.
[745] B Clark and S Tozzi, 'Communication to the Public" Under EU Copyright Law: An Increasingly Delphic Concept or Intentional Fragmentation' (2016) 38(12) EIPR 715; B Clark and J Dickenson, 'Theseus and the Labyrinth? An Overview of "Communication to the Public under EU Copyright Law: After Reha Training and GS Media Where are we Now and Where do we Go from Here?' (2017) 39(5) EIPR 265; J Groom, I Silverman and B Clark, 'Still Lost in the Labyrinth? CJEU Rules in Filmspeler that Pre-loading a Set-top Box with Links to a Pirate Site is a Communication to the Public' (2017) 39(9) EIPR 591.
[746] Other moral rights include the right to decide on the first publication
[747] For instance, D Vaver, 'User Rights' (2013) IPJ 105.
[748] The three-step test found in the Berne Convention is limited to the right of reproduction. However, the TRIPS Agreement, WCT and WPPT apply a variation of this test on all exclusive rights covered by the respective Treaty. T Schönwetter, 'Safeguarding a Fair Copyright Balance – Contemporary Challenges in a Changing World: Lessons to be Learnt From a Developing Country Perspective' (PhD thesis, University of Cape Town 2008) 68–80.

This test generally restricts the introduction of limitations and exceptions to

> special cases which do not conflict with a normal exploitation of the work or other subject-matter and do not unreasonably prejudice the legitimate interests of the rightholder.[749]

Ultimately, it is difficult to accommodate limitations and exceptions to the digital environment, and the rise of digital technologies has led to the emergence of intermediary-specific defences.[750] These rules aim to balance the interests of technology providers, within the dynamic between rights holders and users.

5.2 – Subsistence of Copyright

One of the most important issues raised by 3D printing within copyright is whether CAD models are protected and, to a lesser extent, the subsequently created printing code and 3D printed objects. Chapter One has shown that the CAD model embedded in a design file forms the basis to print a physical object and, consequently, a 3D printed object will always be the—indirect—result of materialising the underlying CAD model.[751] For this reason, the design file is the item that is most likely to be copied and shared. Prior to analysing the impact of 3D printing on copyright infringement, it is therefore important to establish the conditions under which a CAD models embedded in a design file are eligible for copyright protection. Considering the interrelation of the digital and physical works, the question of subsistence of copyright in 3D printed objects is of equal importance.

Essentially, copyright subsist in works that are original and reduced material form.[752] This section will now turn to a discussion of the qualification of CAD models, 3D printed objects and printing code. Thereafter, it will examine core elements of subsistence of copyright regarding CAD models, including originality, the idea/expression dichotomy and authorship.

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[749] Berne Convention, art 9. Similar wording can be found in TRIPS Agreement, art 13; WCT, art 10(2); WPPT, art 16(2).

[750] It remains unclear whether these provisions are defences or immunities. Pistorius, for example, deals with these provisions as 'limitations'. T Pistorius, 'Copyright Law' in H Klopper and others (eds), *Law of Intellectual Property in South Africa* (2nd edn, LexisNexis 2016) 282–85.

[751] See 1.3 – The Technical Aspects of the Generic 3D Printing Process.

[752] South Africa and the UK also require that work is made by a 'qualified person'. See Copyright Act, ss 3(1) and 37; CDPA, s 206.

5.2.1 – Qualification

The digital representation of objects as CAD models inherently embodies all the information to physically manufacture the object.[753] The result is that CAD models have no complete analogue in current legal systems[754] and their qualification thus remains contested and unclear.[755] So far, scholars have mainly adhered to two main schools of thought: The first school argues that CAD models qualify as artistic works, particularly as a 'drawing', while a second school contends that in addition to protection as artistic works, CAD models fit within the scope of 'computer programmes'.[756] Regardless of the qualification, at the core is the question as to what extent copyright in CAD models should be used to—indirectly—protect works that fall outside the scope of its protection.[757] Copyright extends to three dimensional conversion of works, regardless of the format, and the protection of CAD models thus has significant legal implications on the physical reproduction thereof. These results are discussed later.[758]

5.2.1.1 – Artistic Works – The category of artistic works encompasses a group of works that are visually appreciated in some manner or other, including photographs, sculptures, engravings, paintings, drawings and works of artistic craftsmanship.[759] The absence of the prerequisite of artistic quality[760] and the historic broad application

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[753] The CAD model contains all the information regarding the geometry of the object. Additional information such as material and colour can be included in the design file. See 1.3.1 – Modelling: The Creation of the Computer-Aided Design Model.

[754] Osborn (n 21) 562. For an analysis for analogous works to CAD files in the US see K Dolinsky 'CAD's Cradle: Untangling Copyrightability, Derivative Works, and Fair Use in 3D Printing (2014) 71(1) Washington & Lee L Rev 591, 628–42.

[755] It is argued that a CAD model contains both the design itself and the instructions for the 3D printer. See, for example, Dolinsky (n 754) 627.

[756] See, for example, E Lee, 'Digital Originality' (2012) Vand J Ent & Tech 919, 930–32; Dasari (n 130) 291; T Dagne and C Dubeau, '3D printing and the Law: Are CAD Files Copyright-protected?' (2015) 28(1) IPJ 101, 120–21; J Cuzella, 'Fast Fashion: A Proposal for Copyright Protection of 3D-Printed Apparel' (2015) 13 CTLJ 369, 384–85. It must be noted that within legal scholarship there is a confusing and technically incorrect use of terminology regarding CAD models. Most scholars analyse the copyrightability of 'CAD files' rather than 'CAD models'; however, it is evident from their analysis that they in fact look at the protection of the underlying subject matter, *i.e.* the CAD model. See also 1.3.1 – Modelling: The Creation of the Computer-Aided Design Model.

[757] Other elements that contribute to answering this question are the interpretation of 'originality' and the application of limitations and exceptions. These elements are discussed, respectively in 5.2.2 – Originality and 5.3.4 – Limitations and Exceptions. See also 5.4 – The Rights Overlap.

[758] See 5.3.1.2 – Infringement of the Reproduction and Adaptation Rights; 5.4 – The Rights Overlap.

[759] Berne convention, art 2(1). On the national level see Copyrigth Act, s 1, definition of 'artistic work'; CDPA, s 4.

[760] Copyright Act, section 1(1), definition of 'drawing' and 'artistic work'; CDPA, s 4(1)(a).

of this concept supports the qualification of CAD models as 'drawings'.[761] This approach is in the line with the general perception that CAD models are 'design documents' under designs law.[762] In the past, copyright protection has been granted to drawings of functional items in both South Africa and the UK;[763] however, in the UK this had (then) been largely justified by the time and effort exerted in their creation.[764] Moreover, these drawings are static[765] and elements extrinsic to the underlying object make up the copyright protectable features, such as technical drawing lines, measurements and perspective. [766] Such elements are absent from CAD models which represent objects, or at least their shape and geometry, without any features external to the model itself, or a fixed perspective. Originality and copyright, it seems, would therefore need to be established in the underlying object itself. The issue of originality is discussed in the next section.[767]

In absence of a clear definition[768] and judicial clarification it is unclear whether CAD models qualify as 'sculptures' under South African law. Although the term has somewhat been broadened over the years in the UK, the scope remains significantly limited.[769] In *Lucasfilm*,[770] confirmed by the UK Supreme Court,[771] Mann J adopted a multi-factor test to determine what constitutes a 'sculpture'. The test considers the structural nature of the work, the purpose of the work, and the mode

[761] The UK has protected technical drawings of items of industrial design. *British Leyland v Armstrong* [1986] RPC 279; *Plix Products v Frank WinStone* [1986] FSR 92 (NZ); *British Northrop v Texteam Blackburn* [1974] RPC 344. These cases date prior to the CDPA of 1988, and the implications of such protection must be considered considering the fundamental changes introduced by the new Act, in particular section 51. CDPA, s 51. See also 5.3.1.2 – Infringement of the Reproduction and Adaptation Rights; 5.4 – The Rights Overlap.
[762] Mendis (n 18); 3.4.2 – The 'Design Document' under National UDR.
[763] In South Africa, see, for instance, *Pan African Engineers (Pty) Ltd v Hydro Tube (Pty)* Ltd 1972 (1) SA 470 (W); *Scaw Metals Ltd v Apex Foundry (Pty) Ltd* 1982 (2) SA 377 (D); *Klep Valves (Pty) Ltd v Saunders Valve Co Ltd* 1987 (2) SA 1 (A). In the UK, see, for instance, *British Leyland v Armstrong* [1986] RPC 279; *Plix Products v Frank WinStone* [1986] FSR 92 (NZ); *British Northrop v Texteam Blackburn* [1974] RPC 344.
[764] C Fellner, *Industrial Design La*w (Sweet & Maxwell 1995) [1.023], 9. The copyright protection of drawings of functional items can be traced back to 'industrial copyright' which had been adopted in response to the unregistrability of functional designs. See Bently (385). See also 3.1.2.3 – United Kingdom.
[765] The British Court of Appeals held that a common feature of graphic work, including drawings, is their static and non-moving character. *Nova Productions v Mazooma Games* [2007] RPC 25 (CA).
[766] For example, dashed thin lines that represent invisible edges of an object, dashed thick lines with dots that are used to state the special places/surfaces which will processed additionally, and free hand lines that indicate limits of partial and interrupted views and sections.
[767] 5.2.2 – Originality.
[768] The Act defines sculpture as to include 'any cast or model made for purposes of sculpture'. Copyright Act, s1(1), definition of 'sculpture'.
[769] *Wham-O v Lincoln* [1985] RPC 127, 157.
[770] *Lucasfilm v Ainsworth* [2009] FSR (2) 103.
[771] *Lucasfilm v Ainsworth* [2011] UKSC 39; [2012] AC 208

of fabrication. The primary factor appears to be that the work must be enjoyed as a visual item;[772] in other words it must have 'artistic purpose'.[773] This requirement thus bars protection for digital models of primarily functional objects. Moreover, the factor of 'process of fabrication' appears to exclude all digital models from its scope.[774] The creation of CAD models encompasses the use of CAD software and digital elements rather than wood or stone, and the model is shaped using various digital construction processes[775] rather than by carving.[776] A broad interpretation of this factor would, however, allow for CAD models to be regarded as (digital) sculptures.[777] In fact, arguments to treat digital wireframes[778] as sculptures have already been put forward.[779]

Notwithstanding this option, CAD models could obtain protection as works of craftsmanship. Under South African law it is submitted that this concept includes both 'works of artistic craftsmanship' and 'works of craftsmanship of a technical nature',[780] and covers both aesthetic and utilitarian items.[781] In contrast to South Africa, UK copyright law only protects works of *artistic* craftsmanship, and requires

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[772] Lucasfilm (n 770) 153 [118].
[773] ibid, 154 [121].
[774] ibid, 153 [118].
[775] Digital models are the result of both (digital) additive and subtractive processes.
[776] This is supported by the Supreme Court opinion that 'sculpture' should be given its ordinary meaning, which appears to apply to subtractive manufacturing. *Lucasfilm v Ains*worth [2011] UKSC 39; [2012] AC 208, [29]. The Oxford English Dictionary defines sculpture as 'the process or art of carving or engraving a hard material so as to produce designs or figures in relief, in intaglio, or in the round. In modern use, that branch of fine art which is concerned with the production of figures in the round or in relief, either by carving, by fashioning some plastic substance, or by making a mould for casting in metal; the practice of this art'. 'sculpture, n' (*OED Online*, OUP June 2013) <https://www.oed.com/view/Entry/173877> accessed 30 November 2018.
[777] The digital modelling process shows many similarities to physical sculpting. In fact, once of the most common commands used in CAD software is the subtract command, which digitally carves out parts of the model. See, Autodesk, Subtract (Command) <https://knowledge.autodesk.com/support/autocad/learn-explore/caas/CloudHelp/cloudhelp/2018/ENU/AutoCAD-Core/files/GUID-14872FC1-8827-4D3B-978E-20936F9A78E5-htm.html> accessed 30 November 2018.
[778] Wireframes are 3D edge or skeleton CAD representations of objects, and closely resemble CAD models used for 3D printing which are solid models. 1.3.1 – Modelling: The Creation of the Computer-Aided Design Model.
[779] For example, Landsman compares digital wireframes to wire sculptures in the physical world. He refers, amongst other things, to the similarities in the creation which show close resemble, albeit with the difference of being either digital or physical. AC Landsman, 'Fender Bender: 3D Computer Modeling of Commercial Objects and the Meshworks v. Toyota Decision' (2009) 8 J Marshall Rev Intell Prop L 429, 442–44.
[780] *Handbook of South African Copyright Law* (service 14, 2012) 1-12. For a discussion pre-1992 see Dean (n 761).
[781] In the past, courts have accepted that 'works of craftsmanship of a technical nature' include various utilitarian items, including the hull of a boat and the mould from which it was made. *Butt v Schultz* 1984 (3) SA 568 (E); *Schultz v Butt* 1986 (3) SA 667 (A). See also *Bosal Afrika (Pty) Ltd v Grapnel (Pty) Ltd* 1985 (4) SA 882 (C); *Insamcor (Pty) Ltd v Maschienenfabriek Sidler Stalder AG t/a Sistag* 1987 (4) SA 660 (W).

an element of artistic or aesthetic quality.[782] However, it is held that the essential nature of an artistic work requires it to be 'visually significant'.[783] Regardless of an element of artistic or aesthetic quality, works of craftsmanship need to reflect the exercise of craftsmanship, which involves skill on the part of the creator.[784] Craftsmanship is not limited to handicraft skills, but may involve the use of machines, including computer-guides machines, and arguably CAD software.[785]

5.2.1.2 – Computer Programmes – As mentioned, some commentators argue that CAD models could obtain copyright protection as computer programmes.[786] South African copyright law protects computer programmes as a *sui generis* type of work;[787] however, various jurisdictions instead provide copyright protection as literary works.[788] The South African Copyright Act defines a computer programme as

> a set of instructions fixed or stored in any manner and which, when used directly or indirectly in a computer, directs its operation to bring about a result.'[789]

The British case *Autospin Oil (Oil Seals) v Beehive Spinning* supports the qualification of CAD models as computer programmes.[790] In this case, Laddie J states, *obiter dictum*, that digital designs are created by use of computer software and

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[782] CDPA, s 4(1)(a)–(c). *George Hensher Ltd v Restawile Upholstery (Lancs)* Ltd [1976] AC 64, 85H, 8E, 96G.
[783] *Anacon Corp v Environmental Research Technology* [1994] FSR 659, applying *Interlego AG v Tyco Industries Ltd* [1988] RPC 343, 373.
[784] *Vermaat v Boncrest Ltd* [2001] FSR 43.
[785] *George Hensher Ltd v Restawile Upholstery (Lancs) Ltd* [1976] A.C. 64 at 90, 91. Australian courts have held that this skill could even involve a computer-controller machine, provided the resulting work is a manifestation of the creator's skill with the machine, knowledge of materials and pride in workmanship. *Coogi Australia Pty Ltd v Hysport International Pty Ltd* (1998) 157 ALR 247 (Fed ct of Aus).
[786] Osborn argues that a CAD file can qualify as a computer program because 'A CAD file (as I use the term) contains all the information (*i.e.,* 'instructions') to be used by a printer (*i.e.*, a 'computer') to print a three-dimensional object (*i.e.*, 'bring about a certain result').' Osborn (n 331) 825. Several other scholars follow this reasoning. For instance, D Gupta and M Tarlock, '3D printing, Copyright Challenges, and the DMCA' (2013) 38(3) New Matter , 6; Bradshaw, Bowyer and Haufe (n 110) 24; Rideout (n 61) 168. Dagne and Dubeau (756) 119–20; Dolinsky (n 754) 646–50.
[787] Before the 1992 Amendment Act, computer programmes were considered literary works. Copyright Amendment Act 125 of 1992. Currently, the Copyright Act recognises "computer programs" as a *sui generis* category of works. *Cf.* United Kingdom and the US where computer programs are protected as literary works.
[788] For instance, CDPA, s 3(1)(b).
[789] Copyright Act, s 1(1), definition of 'computer program'. The CDPA does not explicitly define the term 'computer program'. A similar definition is found in Commission (EC), 'Copyright and the Challenge of Technology' (Green Paper) COM (88) 172 final, 7 June 1988, 170.
[790] *Autospin (Oil Seals) v Beehive Spinning* [1995] RPC 683.

should, therefore, be treated as lines of computer code.[791] However, there are various arguments against the application of this analogy. This approach focusses on the appearance of the file—the CAD model represented as computer code—instead of what it actually represents, and commentators argue that it is ill-found to regard the underlying computer code of CAD models different from the code in the case of digital music or photographs.[792] In addition, and although accurate, the definition of a computer programme provides an incomplete picture of the operation of a computer program.[793] CAD models themselves do not contain instructions to operate the 3D printer,[794] but merely information or input data that can—indirectly—be used by the printer's software.[795] Consequently, CAD models embedded in a design file should be regarded as input or output data of a computer program.[796]

The subsistence of copyright in print files, and the subsequent legal implications and issues, have been completely neglected in legal literature. These files consist of printer-specific instructions and are created from the CAD model, based on pre-set user preferences, such as layer height and density.[797] These print files can accordingly be qualified as computer programmes within the meaning of copyright law. In fact, the intermediary role of the print file is the exact reason to not qualify CAD models as computer programmes.[798]

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[791] ibid, 698. 'In fact many three dimensional articles are now designed on computers. A literary work consisting of computer code therefore represents the three dimensional article.'

[792] M Antikainen and D Jongsma, 'The Art of CAD: Copyrightability of Digital Design Files' in Rosa Maria Ballardini, Marcus Norrgård and Jouni Partanen (eds), *3D Printing, Intellectual Property and Innovation – Insights from Law and Technology* (Wolters Kluwer 2016) 267-268.

[793] The definition does not mention that a computer program is merely a set of instructions, which operates on input data in order to produce output data. See R de Villiers, 'Computer programs and copyright: The South African Perspective' (2006) 123 SALJ 315, 316.

[794] They require conversion into a print file, which involved 'slicing' – a fact neglected in most legal literature on the topic.

[795] CAD files themselves do not control the operation of a 3D printer, but are merely a triangular representation of a 3D model. B Rideout (n 61) 168: Peacock, 1950–51. See also Dolinsky (n 754) 641–42.

[796] The computer program in this scenario could be the printer program that converts the CAD file (input data) into a set of instructions (for instance, G-code) for the 3D printer (output data) or the CAD program that converts drawing commando's (input data) into a 3D model on the screen (output data).

[797] 1.3.2 – Post-Processing of the Digital Model: The Creation of the Print File.

[798] See footnote 796.

5.2.2 – Originality

When applying the originality standard, South African copyright law follows the traditional British conception of originality, namely the 'sweat of the brow' approach. Under this approach creativity is not a prerequisite for originality.[799] For a work to be original it is required that it is independently created and the result of the author's exertion of independent skill, judgment or labour.[800] The bar for originality required by the Act is thus very low.[801] While this standard has traditionally been applied in the UK, as part of the harmonisation of copyright law in the EU a new concept of originality has been introduced: the work must be the author's own intellectual creation.[802] While in most cases this new standard is unlikely to lead to different results,[803] there might be a different outcome when originality arises through 'mere labour' or 'mere skill'.[804] In the US, the concept of originality means that the work is independently created and possess a minimal degree of creativity.[805] As stated by the Court, the threshold for originality is very low and most works 'make the grade quite easily, as they possess some creative spark, "no matter how crude, humble or obvious" it might be.'[806]

The analysis of originality for CAD models embodying artistic creations is straightforward. Much like any other work created using digital tools, the work will obtain copyright protection to the extent the respective originality requirements are

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[799] *Haupt t/a Softcopy v Brewers Marketing Intelligence (Pty) Ltd 2006* (4) SA 458 (SCA) 473A-B.
[800] AJC Copeling, *Copyright and the Act of 1978* (Butterworths 1978) 15; *Handbook of South African Copyright Law* (service 14, 2012) 1-8; *Kalamazoo Division (Pty) v Gay* 1978 2 SA 184 (C) 192A; *Topka t/a Topring Manufacturing & Engineering v Ehrenberg Engineering (Pty) Ltd* 71 JOC (A) 74; *Barber-Greene Company v Crushquip (Pty) Ltd* 151 JOC (W) 158; *Saunders Valve Co Ltd v Klep Valves (Pty) Ltd* 1985 1 SA 646 (T) 649; *Barker& Nelson (Pty) Ltd v Procast Holdings (Pty) Ltd* 195 JOC (C) at 197; *Klep Valves (Pty) Ltd v Saunders Valve Co Ltd* 1987 2 SA 1 (AD) 22-23; *Waylite Diaries CC v First National Bank Ltd* 1993 2 SA 128 (W) 133A-D; *Appleton v Harnischfeger Corporation* 1995 2 SA 247 (A) 262; *Haupt t/a Soft Copy v Brewers Marketing Intelligence (Pty) Ltd 2*005 (1) SA 398 (C) 413-414; This view was confirmed in *Haupt t/a Softcopy v Brewers Marketing Intelligence (Pty) Ltd 2006* (4) SA 458 (SCA) 473A-B.
[801] For a detailed analysis see S Geyer, 'Determining Originality in Creative Literary Works' (LLD thesis, University of Pretoria 2006) 64–80.
[802] Case C-5/08 *Infopaq International A/S v Danske Dagblades Forening* [2009] ECR I-6569.
[803] EF Judge and DJ Gervais, 'Of Silos and Constellations: Comparing Notions of Originality in Copyright Law' (2010) 27 Cardozo Arts & Ent LJ 381; E Rosati, 'Originality in a Work, or a Work of Originality: The Effects of the Infopaq Decision" (2011) 33(12) EIPR 746, 754–55; E Derclaye and DJ Gervais, 'The Scope of Computer Program Protection after SAS: Are We Closer to Answers? (2012) 34(8) EIPR 565, 567.
[804] Case C- 406/10 *SAS Institute v World Programming* [2012] EU:C:2012:259 [66]. See also Bently and Sherman (n 474) 102–104.
[805] *Feist Publications, Inc. v Rural Telephone Service Co*., 499 U.S. 340 (1991), 345.
[806] ibid.

fulfilled. Works based on previous works, such as stock models, can be partially original.[807]

Complex issues arise, however, with regards to CAD models of objects that are themselves not eligible for copyright protection, such as technical and utilitarian items or mere embodiments of pre-existing material by use of 3D replication technology. It is a general notion that copyright law does not protect functional objects. While purely aesthetic objects will be eligible for relative long-term copyright protection, functional objects potentially enjoy more temporary rights under industrial design or patent protection. The overlap between copyright and industrial design and patent protection in functional objects with aesthetic features is in many jurisdictions clearly delineated.[808] However, (technical) drawings of uncopyrightable subject matter have been protected in the past.[809] Although in the traditional 2D setting it can be held that substantial creative choices were made in the creation of the drawing, including composition, angle, shading and background, this argument does not apply to CAD models.[810] They significantly limit the creator's creative choices relating to elements external to the model itself, and depict the object as it will be materialised.[811] Any measurements, tolerances and other geometrical features are inherent to the model.

Making a three-dimensional scan of an object creates an exact digital copy of a real-life object.[812] It is wrong to draw any analogy with the making of a photograph just because they both create of a real depiction of an existing object. The creator of a photograph makes a series of creative decisions that reflect in a depiction of an existing object in *a certain arrangement*, *from a specific angle and distance, with certain lighting, exposure, etc.*, while 3D replications depict an object *as it is.*[813] Unlike the making of a photograph, the use of 3D replication technology is a more

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[807] See *Klep Valves (Pty) Ltd v Saunders Valve Co Ltd* 1987 (2) SA 1 (A) 25; *Sweeney v Macmillan Publishers Ltd* [2002] RPC 35, [34].
[808] See 5.4 – The Rights Overlap.
[809] *British Leyland v Armstrong* [1986] RPC 279; *Plix Products v Frank WinStone* [1986] FSR 92 (NZ); *British Northrop v Texteam Blackburn* [1974] RPC 344.
[810] See also 5.2.1 – Qualification.
[811] Subject to technical limitations.
[812] The quality of the 3D scan will depend on the scanner used and the amount of post-processing applied.
[813] 3D scanned models can be viewed from the desired angle, distance, etc. The accuracy of the models, including colour, is subject to the respective 3D replication technique.

functional process and does not require any creative input.[814] Some scanning processes, however, require a certain amount of user input,[815] which may influence whether the work is original.[816] 3D models created by labour intensive scanning techniques could qualify as the exertion of independent skill, judgment or labour, and some authors thus argue that copyright could subsist in such scans.[817] The mode of design creation also has consequences for authorship in the work.[818]

However, at the core remains the issue of whether CAD models are independent creations. This issue has been addressed in the US, specifically in relation to digital models. In determining originality, US Courts examine whether during the process of scanning, *i.e.* translating dimensions or medium, the author made changes that were more than 'merely trivial'.[819] They will not consider whether the scanning required of independent skill.[820] In *Meshwerks,*[821] the US Court of Appeals ruled that a wire-frame[822] digital model of a Toyota car, despite human labour, skill and '80 to 100 hours of effort per vehicle',[823] does not meet the originality standard.[824] The court noted that the inquiry for creativity should focus on the resulting model and not the skill, effort and labour involved in the creation thereof.[825] The Court concluded that the Meshwork models are 'not so much independent creations as (very good) copies of Toyota's vehicles.'[826]

Indeed, scanning or other replications generally consist of a mere copying of an existing work—albeit with the change in dimensions and medium. The condition of independent creation not only bars scans based on existing objects to qualify under

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[814] See *Rogers v Koons* 960 F.2d 301, 307 (2d Cir. 1992). Stating that photographs include creativity because of the photographer's choice of 'posing the subject, lighting, angle, selection of film and camera, evoking the desired expression, and almost any other variant involved'. The aim of a 3D scan is to create an exact and accurate replica of the object without any creative input from the person making the scan.
[815] The input requires mechanical decisions, rather than creative ones.
[816] Dasari (n 130) 298.
[817] Mendis (n 1144).
[818] 5.2.4 – Authorship and Ownership.
[819] *Entm't. Research Grp., Inc. v Genesis Creative Grp., Inc*., 122 F.3d 1211, 1222-1223 (9th Cir. 1997); *United States v Hamilton*, 583 F.2d 448, 450 (9th Cir. 1978); *L. Batlin & Son, Inc. v Snyde*r, 536 F.2d 486, 490 (2nd Cir. 1976).
[820] See *Durham Indus. Inc. v Tomy Corp.*, 630 F.2d 905, 910 (2d Cir. 1980); *Gallery House, Inc. v Yi,* 582 F. Supp. 1294, 1297 (N.D. III. 1984).
[821] *Meshwerks, Inc. v Toyota Motor Sales U.S.A., Inc.* 528 F.3d 1258 (10th Cir. 2008).
[822] A skeletal or lattice framework depiction.
[823] ibid, 1261.
[824] ibid,1266. For a detailed discussion, criticisms and suggestions see E Lee, 'Digital originality' (2012) 14 Vanderbilt Journal of Entertainment & Technology Law 919.
[825] ibid, 1268.
[826] ibid, 1264.

US copyright law, but arguably precludes originality for 3D scans under both South African and UK law. However, CAD models created by use of 3D replication technology could meet the originality threshold if original elements are introduced, either by the human or by a computer programme.[827]

Printing code is created by virtually 'slicing' the CAD model. A computer program creates printer-specific instructions based on the input model and selections made by the user, and the printing code thus significantly relies on the underlying CAD model. The selection of layer height, density and other settings is primarily functional, and will not amount 'a modicum of creativity' under US law. While these user-based selections largely determine the quality of the printed object, it is most unlikely that these user-based selections would meet the 'sweat of the brow' standard under South African and UK law. Regardless, copyright in the printing code will be quite narrow considering the mere transformative, yet individualised embodiment of the CAD model.

5.2.3 – The Idea/Expression Dichotomy and Merger

As mentioned at the beginning of this chapter, unprotectable ideas and protected expression can be difficult distinguish. Indeed, sometimes ideas and their expressions are inseparable. The United States recognises the what is referred to as the 'Merger doctrine', which is unknown to South African copyright law. Merger occurs when an idea and its expression are inseparable or an idea can only be expressed in a limited number of ways.[828] The expression will then receive only little, or no, copyright protection 'in order to prevent creation of a monopoly on the underlying "art"'.[829] The leading case on merger, *Herbert Rosenthal Jewelry Corp. v Kalpakian*, explained that 'copying the "expression" will not be barred, since protecting the "expression" in

[827] See, for instance, in the US, *Lucky Break Wishbone Corp. v Sears Roebuck & Co*., 373 Fed. App'x 752 (9th Cir. 2010) 756-757. This case suggests that making changes to a 3D scanned object could add creativity to satisfy the originality requirement. The copyright holder's three-dimensionally scanned a turkey wishbone was used to create graphite electrodes in the wishbone scape. These electrodes were then slightly smoothened and shaped, and subsequently used to make hollow moulds, which were ultimately used for mass production of plastic wishbones. The court held that the smoothing and subtle shaping of the graphite electrodes constituted sufficient original expression to support copyright in the resulting plastic bones. The same reasoning applied to slight changes to a 3D scan would mutatis mutandis lead to original expression to support copyright in the altered scan.

[828] This doctrine must not be confused with the idea/expression dichotomy, which differentiates an idea from the expression of that idea.

[829] *Educational Testing Services v Katzman*, 793 F.2d 533, 539 (3d Cir. 1986).

such circumstances would confer a monopoly of the "idea" upon the copyright owner free of the conditions and limitations imposed by […] patent law'.[830] It is submitted that the merger doctrine might gain more attention as many items created by 3D printing consists of exactly such objects that would fall under the Merger doctrine, such as simple jewellery.[831]

5.2.4 – Authorship and Ownership

5.2.4.1 – Human Involvement and the Design Creative Process – Copyright is constructed around the concept of 'an identifiable, personal author'.[832] The 3D printing design creative process involves the use of computer processes that are characterised by various levels of human technical and creative input.[833] The creation of CAD models through CAD software requires substantial personal input from the creator, and authorship lies with the person that created the model.[834] A second method of creation entails the use of 3D replication technology, and it is unclear to what extent the human involvement contributes to the final expression—the digital model. The CAD model is not created by a person with assistance of the replication technology, but rather replication technology is a tool to capture data which is than translated by computer software into a digital design.[835] 3D replications do, in principle, not attract copyright because of lack of originality; however, the threshold for originality can be met to the extent that some level of originality is added—potentially by a computer programme.[836]

The negligible human involvement in the design creative process likely causes authorship to be established through the principles of computer-generated works.[837] In *Haupt*[838] the South African Supreme Court of Appeals clarified that

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[830] See *Herbert Rosenthal Jewelry Corp. v Kalpakian* 446 F.2d 738, 742 (9th Cir. 1971).
[831] Desai and Magliocca (n 1144) 1708.
[832] Stokes (n 2) 12.
[833] 1.3 – The Technical Aspects of the Generic 3D Printing Process.
[834] See 5.4.2.4 – Decentralised Creativity.
[835] Dagne and Dubeau (756) 125. Referring to AJ Wu, 'From Video Games to Artificial Intelligence: Assigning Copyright Ownership to Works Generated by Increasingly Sophisticated Computer Programs' (1997) 25 AIPLA QJ 131, 142.
[836] 5.2.2 – Originality.
[837] See CDPA, s 178; *Haupt t/a Softcopy v Brewers Marketing Intelligence (Pty) Ltd* 2006 (4) SA 458 (SCA) [31].
[838] *Haupt t/a Softcopy v Brewers Marketing Inteligence (Pty) Ltd* 2006 (4) SA 458 (SCA).

> a work only qualifies as having been computer-generated if it was created by a computer in circumstances where there is no human author of the work.[839]

Authorship in computer generated works lies with 'the person by whom the arrangements necessary for the creation of the work are undertaken'.[840] The meaning of this concept remains largely untested and as a result it is unclear where authorship lies. In the UK, the Whitford Committee suggested that

> the author of the output can be none other than the person, or persons, who devised the instructions and originated data used to control and condition the computer to produce the particular result. In many cases it will be a matter of joint authorship.[841]

5.2.4.2 – Decentralised Creativity – The principle that the author is the person who creates the work[842] does generally not create problems in ascertaining authorship in most literary and artistic works.[843] However, the collaborative nature of the 3D printing community in which the creation of works is often based on pre-existing works, complicates the question regarding authorship. It is increasingly difficult to ascertaining the author's identity and establish whether collaborative and follow-on creations amount to works of sole or joint authorship. The fact that the author is generally the first owner of the work, and has the exclusive right to do or to authorise certain acts in relation to that work, makes these questions pertinent. [844]

Many works in the 3D printing ecosystem are created through some form of collaboration;[845] however, the bar for joint authorship is a high one, and most works will be treated as derivate works of sole authorship.[846] The law applies stringent conditions for joint authorship and avoids confusing patterns of entitlements that are costly to unravel, particularly in the digital environment where contributors are

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[839] ibid, [31]. Similar wording can be found in CDPA, s 178.
[840] Copyright Act, s 1, definition of 'author'; CDPA, s 9(3).
[841] Cmnd.6732 (1977) [514]-[515].
[842] At least for literary and artistic works. Copyright Act, s 1(1), definition of 'author'; s 21(1)(a); CDPA, s9(1).
[843] Bently and Sherman (n 474) 125.
[844] See Article 6bis of the Berne Convention. See also, Copyright Act, s 32(1)(a); 17 USC § 201; CDPA.
[845] As described in 1.4 – The Collaborative Aspects of the Creative Process.
[846] Here, authorship will only lie with the person creating a derivative work if his input is such as to create a new copyright work.

difficult to identify and geographically dispersed.[847] This said, the conditions for joint authorship differ from country to country. In South Africa and the UK, three conditions need to be fulfilled for a work to be a work of joint authorship: (i) each of the authors must have contributed to the making of the work, (ii) the work must have been produced through a process of collaboration, and (iii) the contributions must not be distinct or separate from each other.[848] The first requirement entails that the contribution is original[849] and non-trivial. To fulfil the second requirement, it is not required that both authors had the intent of creating a work of joint authorship,[850] nor that the authors need to be in close proximity of each other.[851] Instead both authors must have a common design or shared goal of some sort.[852] This means, for instance, that where one person creates a design and another improves it by adding or modifying things, the author of the original work will not be a joint author of the second, improved work. The third condition means that the contributions must merge into one unitary whole.[853]

The absence of the name of the author on digital models might complicate ascertaining authorship. Works are considered works of 'unknown authorship' when the identity of the author(s) is unknown and it is not possible for a person to ascertain their identity by reasonable inquiry. [854] The author's name can, however, generally be ascertained via metadata embedded in the file or data accompanying the design file on the file sharing platform. The fact that many of the designs are uploaded under pseudonyms does not impede other users from obtaining the respective permissions.

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[847] Where the law allows a co-author to unilaterally exploit the copyright, each of the co-authors can permit conflicting uses. Conversely, where the law requires the consent of all co-author to exploit the work, lack of consent may cause the work not to be exploited at all.
[848] In absence of judicial interpretation by South African courts, the subsequent analysis if based on case law of the UK.
[849] As discussed supra 5.2.2 – Originality.
[850] *Beckingham v Hodgens* [2003] EWCA Civ 143, [49]. *Cf.* US. For example, *Childress v Taylor*, 945 F.2d 500, 507 (2nd Cir. 1991)
[851] *Cala Homes (South) v Alfred McAlpine Homes East* [1995] FSR 818, 835.
[852] Beckingham (n 850) [51]; *Cala Homes (South) v Alfred McAlpine Homes East* [1995] FSR 818, 835.
[853] 17 USC § 101.
[854] See, for instance, CDPA, ss. 9(4)-9(5).

5.3 – Digitisation, Decentralisation and Copyright Infringement

> [O]nce in digital form, things become easy to copy. This means protecting intellectual property will be just as hard as it is in other industries that have gone digital. Online content will need checking for infringements.[855]

Throughout the 3D printing process, various actors are engaged in potentially copyright infringing acts. It proves difficult to determine exactly what types of rights are infringed, and which limitations, exceptions and defences apply. In spite of uncertainties in the application of the law, the amount of infringement is set to increase as the technology evolves and as more people own, or have access to, 3D printing. However, at present, there have not been any copyright infringements cases regarding to 3D printing-related digital models in South Africa or the other jurisdictions examined.[856]

The most substantial infringement relates to the reproduction and dissemination of CAD models. Digital files are effortlessly reproduced, modified and shared across the Internet, and copyright is easily infringed.[857] It must be noted that while every copy of a CAD file is identical to the original, the subsequent 3D printed objects do currently, at least in the context of consumer 3D printing, not form an adequate substitute for most items.[858] Other infringements relate to the reproduction, adaptation and communication to the public of, parts of, existing copyright objects and CAD models.

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[855] E Barraclough 'A Five-step Strategy for the 3D Revolution' (*Managing Intellectual Property,* 2 November 2011) <https://www.managingip.com/Article/2928093/A-five-step-strategy-for-the-3D-revolution.html> accessed 30 November 2018.

[856] However, several cases have been resolved out of court. See infra note 112. On the other hand, the industrial market has seen increased litigation on 3D printing hardware. For instance, *Barranco v 3D Sys. Corp.*, No. Civ. 13-00411 LEK, 2014 WL 806263 (D. Haw. Feb. 28, 2014). 2014); *3D Sys., Inc. v Formlabs, Inc.*, No. 13 Civ. 7973, 2014 WL 1904365 (S.D.N.Y. May 12, 2014); *Stratasys, Inc. v Microboards Tech., LLC*, No. Civ. 13-3228 DWF/TNL, 2014 WL 5438396 (D. Minn. Oct. 22, 2014).

[857] S Stokes (n 2) 11.

[858] This is mostly due to limitations in size, material, *etc*. See infra 1.3.3 – Printing: Typology of 3D Printing Technologies.

The table below describes the potential infringement of the actors involved.

Act	Actor	Potential Infringement
Creating CAD models, including 3D scanning, modification and remix	User	**Direct**: Reproduction; Adaptation
Sharing, including the act of copying a file to a folder which is publicly available and uploading a file to a file sharing platform	User Design Sharing Platforms	**Direct**: Reproduction; Communication to the Public; Distribution **Moral**: Attribution; Integrity
Downloading, including downloading CAD models from a hosting website or third party's storage device	User 3D Printing Service	**Direct**: Reproduction
Creating G-Code	User Design Sharing Platform (if cloud distribution) 3D Printing Service	**Direct**: Reproduction
3D Printing, including 3D printing through digital dissemination and streaming	User 3D Printing Service	**Direct**: Reproduction
Streaming	ISP Design Sharing Platform (if cloud distribution)	**Direct**: Reproduction; Communication to the Public(?); Distribution(?); Public Performance(?) **Moral**: Attribution, Integrity
Facilitating	ISP Design Sharing Platforms 3D Printing Technology Providers	**Direct**: Authorising all of the above-mentioned acts **Indirect**: Facilitating all off the above-mentioned acts

Figure 6 – Direct and Indirect Infringement within the 3D Printing Process

5.3.1 – Direct Infringement

Direct infringement occurs when a restricted act is carried out without the owner's consent, in relation to a work or a substantial part thereof. It involves a causal connection between the copyright work and the allegedly infringing work, and thus involves actual copying. Users are the group of actors predominantly involved in primary infringement; however, intermediaries also engage in activities that directly infringe the owner's exclusive rights, including by authorising any of these acts.[859]

[859] Copyright Act, s 23(1); CDPA, s 16(2).

5.3.1.1 – Preliminary Remarks on Substantiality of the Work – An action for direct infringement requires that the restricted act has been carried out in relation to a substantial part of the work.[860] Making identical reproductions of objects, either in digital or physical form, raises no issues; however, the question of substantial copying becomes relevant in two distinct cases: (i) the creation (including scanning), adaptation and modification of CAD models, and (ii) the multi-source file-sharing of small portions of a file. Various factors have been applied in determining whether or not a part was substantial, particularly the quantity and quality taken.

First, the creation of CAD models is the result of the exertion of different levels of creative and physical input. On the one side of the spectrum, designers make digital models from scratch by using their own skill, imagination and creativity. In this case, infringement will be absent.[861] On the other side of the spectrum, designers (partly) create CAD models by copying stock models or by simply scanning existing objects. In between these two extremes is a grey area of adaptation, modification and remixing of existing designs. Designs that reproduce a substantial part[862] of a previous work could infringe the right of reproduction and adaptation. The outcome of such cases is, ultimately, dependent on a case-by-case analysis.

The qualification of CAD models becomes increasingly important within this analysis. In particular, the characterisation of CAD models as computer programmes would pose significant issues in establishing similarities, and subsequent infringement. Minor alterations to the visual features of the model will result in significantly different code and thus lack literal similarity. Although the scope of protection for computer programmes extends beyond literal components, the test for non-literal copying consist of emulating aspects of the programme that are largely inapplicable in relation to CAD models, such as structure and sequence of operations.[863] Ultimately, it is the underlying model that needs to be assessed for its visual elements, rather than the underlying code for literal or non-literal similarities.

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[860] Copyright Act, s 1(2A); CDPA, s 16(3)(a).
[861] The independent creation of a work substantially similar to a pre-existing work will not infringe copyright. Cf. Patent.
[862] *Haupt t/a Softcopy v Brewers Marketing Intelligence (Pty) Ltd 2006* (4) SA 458 (SCA) 475H–476B. (the criterion for establishing substantial similarity is both quality and quantity, of which the former is most important)
[863] *Ibcos Computers v Barclays Mercantile Highland Finance* [1994] FSR 275, 292, 302; *Cantor Fitzgerald International v Tradition* (UK) [2000] RPC 95, 133–34.

A second issue is the legal uncertainty in the case of an incomplete download from multiple sources[864] or when streaming a digital file directly to the printer, often including 'buffering'.[865] Incomplete downloads make it difficult to establish when a packet, or how many of them, constitute a substantial part of the work.[866] Courts have held that both quantity and quality of the portion taken must be taken into account, of which the latter is most important.[867] These criteria are impracticable in relation to digital downloads where it will be impossible to establish whether or not the part copied is of qualitative importance. Similar substantiality issues arise as the result of streaming. Although during this process a transient (partial) copy might be created, it is unclear whether this copy is substantial. However, 3D printing an object by streaming a design or print file will nonetheless indirectly reproduce the CAD model.[868] At present, no such case has been dealt with in South Africa or the UK.[869]

With the aforementioned discussion in mind, the following analysis is based on the assumption of misappropriation of a substantial part of the work.

5.3.1.2 – Infringement of the Reproduction and Adaptation Rights – Reproduction is at the heart of the 3D printing process.[870] Most instances of copyright infringement by users will be through reproducing works during the creation, modification, and subsequent materialisation of CAD models.[871] Although most of these acts involve indirect copying, *i.e.* copying a work that is itself copied from the original work,[872] the legitimacy of intermediate reproductions is insignificant for establishing infringement.[873]

The creation of digital models involves reproduction in the situation where the underlying designs are copyright-protected works, in particular artistic works.

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[864] For example, through Peer-to-Peer file sharing technology.
[865] Streaming does not create a complete copy of the file on the hard drive.
[866] Based on the maxim *de minimis non curat lex*, infringement only takes place when a substantial part of the work has been copied. Section 1(2A) of the Copyright Act reaffirms this maxim by limiting scope of the Copyright Act to acts performed 'in relation to any substantial part of [a] work'.
[867] *Haupt t/a Softcopy v Brewers Marketing Intelligence (Pty) Ltd 2006* (4) SA 458 (SCA) 475H-476B.
[868] See following section.
[869] See however *Australian Video Retailer Association Ltd. v Warner Home Video Pty Ltd.* [2001] FCA 1719 (AU), where it was held that temporary copies made during playing a DVD were too small.
[870] See 1.3 – The Technical Aspects of the Generic 3D Printing Process.
[871] Copyright Act, s 7(a); CDPA, s 17. Copying includes the making of transient copies of the work. CDPA, s 17(6).
[872] Most often the initial CAD model.
[873] See, for instance, CDPA, s 16(3).

Reproduction is a broad concept, and for artistic works includes the conversion of a work in two dimensions to three dimensions, or *vice versa*.[874] The Berne Convention provides that

> [a]uthors of literary and artistic works protected by this Convention shall have the exclusive right of authorizing the reproduction of these works, *in any manner or form*.[875]

Considering this broad scope, it is submitted that the conversion of a physical three-dimensional work to digital format amounts to reproduction. The modification of existing CAD models that results in a substantially similar model also constitutes an act of reproduction.[876]

The subsequent materialisation of CAD models encompasses making both permanent and transient reproductions during the processing of the CAD models. These reproductions take place during the initial download of the design file, the conversion from CAD models into G-code, and the use of the printing code by the 3D printer's software. As was established above, it remains unclear, however, whether 3D printing through streaming constitutes reproduction.[877] While the status of intermediary copies is complex, 3D printing nonetheless constitutes an *indirect reproduction* of the initial CAD model from which the 3D printed object has been created.[878] Taking into consideration the broad scope of 'reproduction' as discussed above, copyright protection in CAD models extends to the corresponding physical output, regardless of their nature. The result is that manufacturing a utilitarian objects could (indirectly) infringe the underlying design drawing or CAD model. This issue is discussed later.[879]

The reproduction right takes central place in the digital environment, with the result that the right to adaptation is easily overlooked. Another reason for this oversight is that the adaptation right does generally not apply to artistic works, but to literary and dramatic works.[880] However, under the South African definition for

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[874] Copyright Act, s 1(1), definition of 'reproduction', (b). A similar definition can be found in CDPA, s 17(3).
[875] Berne Convention, art 9(1). Emphasis added
[876] As discussed in 5.3.1.1 – Preliminary Remarks on Substantiality of the Work.
[877] See 5.3.1.1 – Preliminary Remarks on Substantiality of the Work.
[878] Or a pre-existing physical work in the case where the CAD model embodies a pre-existing object.
[879] 5.4 – The Rights Overlap.
[880] 5.1.2.2 – The Adaptation Right.

adaptation,[881] it can be argued that certain acts, such as the conversion of a CAD model into G-code, and subsequently into a physical object also infringe on the right of adaptation.

5.3.1.3 – Infringement of the Communication to the Public Right (incl. Making Available and Distribution) – Design sharing platforms may infringe the right of distribution by physically distributing copyright protected 3D printed objects. [882] However, the primary threat to rights holders appears to be the unauthorised dissemination of CAD models in the digital environment. The distribution right does arguably not apply in relation to CAD files.[883] South Africa's copyright law does currently not contain a right to communicate to the public, and in the absence of case law, it remains unclear to what extent the right to distribution is infringed by online sharing.[884] It should, however, be noted that the draft Copyright Amendment Bill introduces a right to communication to the public into South African law.[885] Therefore, a substantial comparison with the interpretation of such right under UK and EU law is useful.[886]

Uploading a CAD model to a sharing platform falls within the ambit of communication to the public considering a transmission takes place from the user's computer to the hosting website which is publicly accessible. For some time, it was unclear whether the placing of files in a shared folder to be used over a Peer-to-Peer (P2P) network constitutes a communication to the public considering there was no 'transmission'.[887] In the British case *Polydor Ltd v Brown,*[888] the court held that

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[881] The Copyright Act defines adaptations for artistic works as to include 'a transformation of the work in such a manner that the original or substantial features thereof remain recognizable'. Copyright Act, s1, definition 'adaptation'.
[882] In as far as these objects are eligible for copyright protection. 1.5.2 – Physical Distribution.
[883] 5.1.2.3 – The Distribution Right. However, in the US the electronic file transfer qualifies as distribution. *London-Sire Records, Inc. v Doe* 1, 542 F.Supp.2d 153 (D. Mass 2008). It remains unclear whether the mere making available of files suffices or actual transmission is required to constitute distribution. For a brief discussion of the relevant cases see M Schlesinger, 'Legal Issues in Peer-to-Peer File Sharing, Focussing on the Making Available Right' in Alain Strowel (ed), Peer-to-Peer File Sharing and Secondary Liability in Copyright Law (Edward Elgar 2009) 65-66.
[884] Copyright Act, s 23(2).
[885] See Copyright Amendment Bill, s 6(a).
[886] CDPA, s 20(2)(b). Generally, on the definitions of communication to the public see K Garnett, G Davies and G Harbottle, *Copinger and Skone James on Copyright,* vol 1 (17th edn, Thomson Reuters 2017) 7-205 *et seq*.
[887] The UK CDPA uses the terminology 'electronic transmission'. This language differs from the terminology used in Article 3(1) of the Copyright Directive and Article 8 WCT, which use the terminology 'by wire of wireless means'.

placing files in a shared folder to be used over a P2P network constitutes communication to the public, regardless of actual transmissions taking place. This approach is in the line with the rich body of case law on communication to the public right established by the CJEU.[889]

The law is silent as to who actually communicates the work to the public: the platform users who uploads the file or the design sharing platform. It can be argued that it is typically the user that makes the file available, and the design sharing platform is a mere intermediary. Considering the construction of the right of communication to the public by the CJEU in *Reha Training*[890] and *GS Media*,[891] it is uncertain whether intermediaries, particular hosting providers, can be deemed to perform acts of communication to the public relating to works uploaded by their users.[892] However, ancillary acts may constitute communication to the public, for instance linking to infringing content or facilitating the location of infringing works. In *Brein v Ziggo*,[893] the CJEU interpreted the right of communication to the public as

> the making available and management, on the internet, of a sharing platform which, by means of indexation of metadata referring to protected works and the provision of a search engine, allows users of that platform to locate those works and to share them in the context of a peer-to-peer network.[894]

5.3.2 – Indirect Infringement

Copyright provides remedies not only against acts of direct infringement but extends to acts of accessorial infringement. Broadly, indirect infringement entails dealing in

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[888] [2005] EWHC 3191 (Ch). See also Garnett, Davies and Harbottle (n 886) 7-134.
[889] Most notably Case C-89/04 *MediaKabel BV v Commissariaat voor de Media* [2005] ECR I-4891; Joined cases C-403/08, C-429/08 *Football Association Premier League Ltd (FAPL) v QC Leisure and Karen Murphy v Media Protection Services* [2011] ECR I-9083; Case C-466/12 *Svensson v Retriever Sverige AB* EU:C:2014:76, [2014] Bus L R 259; Case C-117/15 *Reha Training v GEMA* EU:C:2016:379; Case C-160/15 *GS Media BV v Sanoma Media Netherlands BV* EU:C:2016:644, [2016] Bus L R 1231; Case C-527/15 *Stichting Brein v Wullems (t/a Filmspeler)* EU:C:2017:300, [2017] ECDR 14; Case C-610/15 *Stichting Brein v Ziggo BV and XS4All Internet BV* EU:C:2017:456.
[890] Case C-117/15 *Reha Training v GEMA* EU:C:2016:379.
[891] Case C-160/15 *GS Media BV v Sanoma Media Netherlands BV* EU:C:2016:644, [2016] Bus L R 1231.
[892] E Rosati, 'Why a Reform of Hosting Providers' Safe Harbour is Unnecessary under EU Copyright Law' (2016) 38(11) EIPR 668, 673-675. The concept 'indispensable intervention' is one of the users, rather than the intermediary. However, broader interpretations of the nation of 'indispensable intervention' has been proposed.
[893] Case C-610/15 *Stichting Brein v Ziggo BV and XS4All Internet BV* EU:C:2017:456.
[894] ibid, [48].

infringing copies and facilitating acts of direct infringement. It is suggested that design sharing platforms are not specifically aimed at the exchange or processing[895] of infringing files; however, in the event that they are used for infringing purposes, they may become liable by facilitating and inducing reproduction and dissemination of the work. Design sharing platforms normally require the user-uploader to guarantee that the uploaded files do not infringe any third party's copyright, and many platforms may not be aware of any actual infringing content.[896] However, lack of knowledge does not *per se* eliminate potential liability.

The South African Act solely provides for indirect infringement in the form of dealing with infringing articles;[897] however, the significance of this provision is minor and this chapter has shown that dealing with infringing *digital* copies constitutes an act of direct infringement: reproduction.[898] The result is that dealing with infringing copies only applies to *physically* 3D printed objects that are eligible for copyright protection. In practice, these provisions only concern the actors involved in physical design distribution, including consumers and 3D printing services. In addition to dealing with infringing copies, section 24 of the UK CDPA penalises the making, importation or possession of an article for the making of infringing copies; however, this article must be '*specifically* designed or adapted for making copies of [a certain work]', and the alleged infringer must have actual of reasonable knowledge that the article is used for infringing purposes.[899] The general purpose of 3D printing technology excludes it from this provision.

In several landmark cases the US has developed the doctrines of contributory and vicarious infringement. Contributory infringement arises when the defendant 'with knowledge of the infringing activity, induces, causes or materially contributes to the infringing conduct of another […].'[900] In South Africa neither the Copyright Act nor any published decision address contributory infringement, however, there are indications that South African courts are prepared to accept this concept.[901]

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[895] Including the physical manufacturing.
[896] ibid.
[897] Copyright Act, s 23(2).
[898] 5.1.2 – Rights Conferred by Copyright; 5.3.1 – Direct Infringement.
[899] CDPA, s 24(1). Emphasis added.
[900] Contributory infringement was first established in *Gershwin Publishing Corp. v Columbia Artists Management Inc.*, 443 F.2d 1159 (2d Cir. 1971).
[901] There are indications that South African courts are prepared to accept this concept. See, for instance, *Bosal Africa (Pty) Ltd v Grapnel (Pty) Ltd* 1985 (4) SA 882 (C) 893.

In the *Betamax case*[902] it was held that a device capable of substantial non-infringing uses (COSNU) does not constitute contributory infringement.[903] This implies that general knowledge of infringing content on design sharing platforms or infringing uses of 3D printing technology will not result in secondary liability. The rationale behind Betamax has been merged into the safe harbour provisions.[904]

In *A&M Records v Napster*,[905] the Ninth Circuit had to consider both these principles laid down in the *Betamax case* and new provisions introduced by the DMCA in order to decide on contributory infringement, this time in relation to P2P file sharing. The court decided that Napster 'had knowledge, both actual and constructive, of direct infringement'[906] and could therefore not rely on the 'safe harbour' provisions. Moreover, it appears that in absence of knowledge, the *Betamax doctrine* does preclude liability when the service providers promote infringement.[907]

5.3.3 – Infringement of Moral Rights

Users potentially infringement the author of the original design's right to integrity when in customising, modifying and remixing works, the original works are treated in a derogatory manner.[908] It remains unclear to what extent the right to attribution is infringed by the physical production of a design without mentioning the author, or how such attribution would work in practice.[909] In the digital environment design

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[902] *Sony Corp. v Universal Studios, Inc*., 446 U.S. 417 (1984). Sony manufactured home video tape recorders which allowed users to record television broadcasts, hence enable them to infringe copyright.
[903] ibid, 418.
[904] See 5.3.5 – Safe Harbours.
[905] *A&M Records Inc. v Napster Inc.*, 114 F Supp 2d 896 (N.D. Cal. 2000); 54 USPQ 2d 1746 (N.D. Cal. 2000); 239 F 3d 1004; 57 USQP 2d 1729 (9th Cir. 2001); WL 227083 (ND Cal. 5 March 2001); 284 F.3d 1091 (9th Cir. 2002).
[906] ibid, 1020.
[907] *Metro-Goldwyn-Mayer Studios Inc v Grokster Ltd*, 125 S. Ct. 2764 (2005), 2780.
[908] If it amounts to distortion or mutilation of the work or is otherwise prejudicial to the honour or reputation of the author or director. CDPA, s 80(2)(b).
[909] M Weinberg, 'BY 3D? Creative Commons Attribution and 3D Printing' (*Shapeways Magazine,* 28 October 2015) <https://www.shapeways.com/blog/archives/22679-by-3d-creative-commons-attribution-and-3d-printing.html#comment-168510?awc=6920_1523007789_61b4724893c2921dc69aab7b58898f41&utm_source=affiliatewindow&utm_medium=affiliate&utm_campaign=affiliate> accessed 30 November 2018; J Park, 'How Should We Attribute 3D Printed Objects?' (*Creative Commons Blog*, 19 April 2016) <https://creativecommons.org/2016/04/19/attribute-3d-printed-objects> accessed 30 November 2018.

sharing platforms too risk liability by falsely or wrongly attributing designs.[910] However, moral rights can be waived.[911] In fact, many online platforms require uploaders to waive their moral rights, particularly the right of attribution of authorship.[912]

5.3.4 – Limitations and Exceptions

Limitation and exceptions exist in many forms; generally qualified under the terms fair use, fair dealing and enumerated uses.[913] The system of limitations and exceptions is crucial to allow for the use of works in the digital environment, which involves reproduction, including temporary, transient, and incidental copying.[914] In addition to simple use, Chapter One has shown that an integral part of artistic creation consist of follow-on creation.[915] These transformative uses clash with regime of exclusive rights; yet, the aim of copyright is to promote all forms of creativity, however alien they are to the 'traditional' understanding of creativity. It is, therefore, held that optimising creative production requires a careful balance between granting authors protection in order to generate income from their work, and limitations and exceptions that permit transformative uses of these works.[916]

Apart from balancing the interests of rights holders and the public by permitting certain uses, limitations and exceptions also limit the extent to which copyright can be used in order to protect the manufacturing of non-copyright eligible objects. Copyright law protects drawings without regard of the nature of the

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[910] CDPA, s 84(6).
[911] *Handbook of South African Copyright Law* (service 15, 2015) 5-2, 5-3, 5-19 and 5-23. See also CDPA, s 87(2).
[912] Makerbot, 'Makerbot Terms of Use' (17 October 2017), clause 3.2 <https://www.makerbot.com/legal/terms> accessed 30 November 2018; Autodesk, 'Terms of Service for Autodesk 123DAPP.com (12 June 2015), clause 3b <https://www.autodesk.com/company/legal-notices-trademarks/terms-of-service-autodesk360-web-services/terms-of-service-for-123dapp> accessed 30 November 2018.
[913] Other authors differentiate between open and closed systems of exceptions. See A Lepage, 'Overview of Exceptions and Limitations to Copyright in the Digital Environment' (2003) e-Copyright Bulletin, 5–6 <http://unesdoc.unesco.org/images/0013/001396/139696e.pdf> accessed 30 November 2018.
[914] Without having to obtain explicit authorisation from the rights holders.
[915] 1.4.2 – Peer Production (Including Follow-on Creation).
[916] R Okediji, 'The International Copyright System: Limitations, Exceptions and Public Interest Considerations for Developing Countries', Issue Paper No. 15, International Centre for Trade and Sustainable Development (ICTSD) and UN Conference on Trade and Development (UNCTAD). (2006) <http://unctad.org/en/docs/iteipc200610_en.pdf> accessed 30 November 2018.

underlying subject matter, and objects that are as such ineligible for copyright protection could obtain copyright protection through the protection of the CAD models. In this context, limitations and exceptions can be used to reshape the scope of copyright by, for instance, excluding from copyright infringement the materialisation of particular subject matter to a CAD model. This issue is discussed later in detail.[917]

The national frameworks for of limitations and exceptions within the 3D printing ecosystem is discussed in the following paragraphs.

5.3.4.1 – South Africa – The general fair dealing exceptions provided for in section 12 of the Copyright Act[918] are limited to certain purposes that are largely unrelated to 3D printing-specific dealings, including purposes of research or private study, purposes or criticism or review of that work, and purposes of reporting current events. In addition, the category-specific exceptions for artistic works in Section 15 do not contain any provision applicable to the digital use and 3D printing. This said, section 12(1)[919] states:

> Copyright shall not be infringed by any fair dealing with a literary or musical work—
>
> (a) for the purposes of research or private study by, or *the personal or private use of, the person using the work*.[920]

This exception for personal or private uses could cover the making of temporary or technology-dictated copies, at least to the extent this use is consider 'fair'. In absence of case law the details of what comprises 'fair dealing' remain unclear.[921] The Copyright Amendment Bill introduces broader general exceptions, influenced by the US fair use approach.[922] However, it remains uncertain to what extent these proposed limitations and exceptions will make it into law.[923]

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[917] 5.4.1 – Copyright-Design.
[918] Section 15-19B extend the scope of the fair dealing provision to artistic works, cinematograph films, sound recordings, broadcasts, published editions, and computer programs. With reference to artistic works it is stated that sections 12 (1), (2), (4), (5), (9), (10), (12) and (13) shall mutatis mutandis, in so far as they can be applied. Programme-carrying signals are not covered in this context.
[919] For artistic works via s 15(4).
[920] Emphasis added.
[921] See, however, Moneyweb v Media24 for a non-exhaustive list of fairness factor in relation to s 12(1)(c)(i). *Moneyweb v Media 24* [2016] 3 All SA 193 (GJ); 2016 (4) SA 591 (GJ).
[922] This Bill has not yet been enacted, and at the time of writing there remained great uncertainty as to whether it will become operational any time soon. See also fn 685.
[923] The enactment of new limitations and exceptions will underline a need for research on this issue.

5.3.4.2 – European Union/United Kingdom – During the printing process users will inevitably make multiple reproductions of the design file and thus the CAD model. In accordance with the InfoSoc Directive,[924] the CDPA excludes from liability the making of a 'temporary technology-dictated' copies:

> Copyright in [an] artistic work […] is not infringed by the making of a temporary copy which is transient or incidental, which is an integral and essential part of a technological process and the sole purpose of which is to enable— (a) a transmission of the work in a network between third parties by an intermediary; or (b) a lawful use of the work; and which has no independent economic significance.[925]

In *Infopaq I,*[926] the court held that for copies to be 'transient and incidental' they must be 'created and deleted automatically and without human intervention'[927] In *Infopaq II*,[928] the CJEU elucidated certain aspects relating to acts of temporary reproduction, including that the technological process can be initiated by a human being.[929] While in most cases G-code cannot be considered a non-transient copy, the use of a print file through streaming would qualify under this exception.[930]

In addition, the Directive allows Member States to adopt a private copying regime, which allowed users to copy legally obtained content to another medium or device for private use.[931] This would include the copying of a legally obtained design or print file to a flash drive to put directly into a 3D printer, but not the actual use, including processing and materialisation. The private copying exception is conditional to fair compensation of the rights holders, in many EU Member States in the form of a levy system.[932] In *Padawan*[933] the CJEU held that Member States are free to determine 'the form, detailed arrangement for financing and collection, and

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[924] InfoSoc Directive, art 5(1).
[925] CDPA, s 28(A).
[926] Case C-5/08 *Infopaq International A/S v Danske Dagblades Forening (InfoPaq I)* ECR I-6569.
[927] ibid, [61]-[64].
[928] Case C-302/10 *Infopaq International A/S v Danske Dagblades Forening (Infopaq II)* EU:C:2012:16.
[929] ibid, [36].
[930] See 1.3.2 – Post-Processing of the Digital Model: The Creation of the Print File.
[931] Copyright Directive, art 5(2)(b).
[932] M Kretschmer, 'Private Copying and Fair Compensation: An Empirical Study of Copyright Levies in Europe', IPO report 2011/9 (2011) <https://www.gov.uk/government/publications/private-copying-and-fair-compensation> accessed 30 November 2018.
[933] C-467/08 *Padawan v SGAE* [2010] ECR I-10055. See also C-462/09 *Stichting de Thuiskopie v Opus Supplies Deutschland GmbH* [2011] ECR I-05331.

the level of [fair] compensation'.[934] In the EU, levies are imposed on various media, including blank media such as CDs, media players, computers and printers—albeit not 3D printers. In 2014, the UK government introduced an exception for personal copies for private use.[935] The provision did, however, not provide for 'compensation'[936] and in *R v Secretary of State for Business, Innovation and Skills,*[937] the court quashed the provision with prospective effect.

The UK *freedom of panorama* exception excludes from copyright infringement the making of CAD models of existing copyright works, particularly buildings, sculptures, models for buildings and works of artistic craftsmanship, to the extent that these works are 'permanently situated in a public place or in premises open to the public'.[938] The application of this provision is subject to CAD models being qualified as a 'graphic work representing [the existing copyright work]'.[939] Although the physical production of the work according to the CAD model would amount to copyright infringement by indirect copying; it appears that the mere communication to the public of such CAD models would not infringe copyright.[940]

Provisions that allow for follow-on creation appear to be limited, and research has found that in absence of flexibilities the law is particularly restrictive regarding transformative uses of copyright works.[941]

5.3.4.3 – United States – The judicially created fair use doctrine has a statutory basis in section 107 of the Copyright Act,[942] and allows the use of a work for any purposes as long as it qualifies as 'fair' under an open-ended list of fairness factors. Being an open-ended clause, section 107 is considered to be flexible regarding new

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[934] ibid, [37].
[935] CPDA (UK), s 28B. The Copyright and Rights in Performances (Personal Copies for Private Use) Regulations 2014
[936] *Cf*. InfoSoc Directive, art 5(2)(b).
[937] *R (British Academy of Songwriters, Composers and Authors and others) v Secretary of State for Business, Innovation and Skills* [2015] EWHC 2041
[938] CDPA, s 62.
[939] CDPA, s 62(2)(a).
[940] CDPA, s 62(3).
[941] See J Cabay and M Lambrecht, 'Remix Prohibited: How Rigid EU Copyright Laws Inhibit Creativity' (2015) 10(5) JIPLP 359; PB Hugenholtz and M Senftleben, 'Fair Use in Europe. In Search fo Flexibilities' Amsterdam Law School Research Paper No. 2012-39, Insttute for Information Law Research Paper No. 2012-33 (March 2012) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2013239> accessed 30 November 2018.
[942] Act of 1976.

kinds of uses,[943] with significant benefits the creative industries.[944] The fairness factors include (1) the purpose and character of the use, (2) the nature of the copyrighted work, (3) the amount and substantiality of the portion used in relationship to the copyrighted work as a whole, and (4) the effect of the use upon the potential market for or value of the copyrighted work.[945] This latter factor might become more important as 3D printing technology continues to improve and more people are able to create exact replicas of works with increased detrimental effect on potential market.[946]

The fair use factors favour the finding of fair use for the use of lawfully obtained CAD models within the 3D printing process, such as the making of temporary and transient reproductions.[947] However, the dissemination, downloading and materialisation of CAD models consists of non-transformative use of works that are highly creative and used in their entirety, and will thus most likely not qualify as fair use.[948] This is almost certainly the case when these uses take place within a commercial setting.[949]

Fair use is partly based on the premise that the purpose of copyright is to promote ongoing progress of authorship, including follow-on creation.[950] The assessment of remixed works requires a qualitative and quantitative analysis of what is copied from the original work.[951] Taking a small portion of a work which is considered the 'heart of the [work]' will nonetheless disfavour fair use.[952] However, when this element only constitutes a small part of the new work, the balance might

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[943] S Ricketson, 'WIPO Study on Limitations and Exceptions of Copyright and Related Rights in the Digital Environment', SCCR/9/7 (WIPO 2003) <https://www.wipo.int/edocs/mdocs/copyright/en/sccr_9/sccr_9_7.pdf> accessed 30 November 2018.
[944] P Jaszi, M Carroll, S Flynn, M Palmedo, K Weatherall and A Katz, 'Evaluating the Benefits of Fair Use: A Response to the PWC Report on the Costs and Benefits of "Fair Use", Report submitted to the Australia Productivity Commission (2016, 15 April) <https://papers.ssrn.com/abstract=2773646> accessed 30 November 2018; Deloitte, 'Copyright in the Digital Age - An Economic Assessment of Fair Use in New Zealand' (March 2018) 20–29 <https://www2.deloitte.com/content/dam/Deloitte/nz/Documents/Economics/dae-nz-copyright-fair-use.pdf> accessed 30 November 2018.
[945] 17 USC § 107.
[946] Reddy (n 21) 237. See also *Perfect 10, Inc. v Amazon, Inc*, 508 F.3d 1146, 1168 (9th Cir. 2007). (clarifying that the harm to a market cannot be purely hypothetical)
[947] Including the right to use the file for 3D printing purposes.
[948] Although the level of creativity will depend on the characteristics of the underlying objects, most models will be of a highly creative nature.
[949] Every commercial use of a copyrighted materials in presumptively unfair. *Sony corp. v Universal Studios, Inc*., 446 U.S. 417, 451 (1984).
[950] P Samuelson, 'Freedom to Thinker' (2016) Theoretical Inquiries L 563, 577–78.
[951] *Campbell v Acuff-Rose Music*, 510 U.S. 569, 586-587 (1994).
[952] ibid, 589.

shift back towards a finding of fair use.[953] Adapting a work with new 'expression, meaning, or message' likewise favours the finding of fair use.[954]

5.3.5 – Safe Harbours

Intermediaries provide services and infrastructure that could facilitate copyright infringement. At the same time, they are key actors in enabling sharing and distribution of content and providing platforms for co-creation and peer production. This double role raises questions concerning their liability. In the US, the DMCA introduced 'safe harbour' provisions for intermediaries, exempting them from monetary damages.[955] These provisions have been subject to significant criticism and debate,[956] and they are currently under scrutiny.[957] Mirrored after the DMCA and the comparable provisions in the European E-Commerce Directive, the South African Electronic Communications and Transactions (ECT) Act of 2002 introduced various immunities from liability applying to the following activities: 'mere conduit', 'caching', and 'hosting'.[958] The backbone of these provisions is that there is no general obligation on service providers to monitor what is being stored on their servers.[959]

Of particular relevance within the 3D printing ecosystem are the provisions relating to 'mere conduit' and 'hosting'.[960] The 'mere conduit' provision of the ECT Act states:

> A service provider is not liable for providing access to or for operating facilities for information systems or transmitting, routing or storage of data messages via an information system under its control, as long as the service provider— (a) does not initiate

[953] *Bill Graham Archives v Dorling Kindersley Ltd*., 448 F.3d 605, 613 (2d Cir. 2006).
[954] *Campbell v Acuff-Rose Music, 510 U.S.* 569 at 589 (1994).
[955] In particular, via the Online Copyright Infringement Liability Limitation Act (OCILLA). 17 U.S.C.A. § 512.
[956] See, for instance, M Lubitz, 'Liability of Internet Service Providers Regarding Copyright Infringement – Comparison of U.S. and European Law' (2002) 33 IIC 26, 39.
[957] The US Copyright Office is examining the impact and effectiveness of the safe harbour provisions under the DMCA. US Copyright Office, 'Section 512 Study' <https://www.copyright.gov/policy/section512> accessed 30 November 2018. In the EU, the copyright framework is being reformed. 'Modernisation of the EU Copyright Rules' <https://ec.europa.eu/digital-single-market/en/modernisation-eu-copyright-rules> accessed 30 November 2018.
[958] ECT Act, ss. 73-76. It further provides a linking defence.
[959] ECT Act, s 78; E-Commerce Directive, art 15.
[960] 'Caching' concerns search engines, and is therefore outside the scope of this work.

> the transmission; (b) does not select the addressee; (c) performs the functions in an automatic, technical manner without selection of the data; and (d) does not modify the data contained in the transmission.[961]

This immunity primarily applies to ISPs. However, it can be argued that they would nonetheless be an 'involuntary copier'.[962] Of primary relevance to design sharing platform is the 'hosting' safe harbour, which provides:

> A service provider that provides a service that consists of the storage of data provided by a recipient of the service, is not liable for damages arising from data stored at the request of the recipient of the service, as long as the service provider— (a) does not have actual knowledge that the data message or an activity relating to the data message is infringing the rights of a third party; or (b) is not aware of facts or circumstances from which the infringing activity or the infringing nature of the data message is apparent; and (c) upon receipt of a take-down notification […], acts expeditiously to remove or to disable access to the data.[963]

Design sharing platforms are required to expeditiously remove the infringing material the moment they have actual knowledge of infringement taking place. In many instances, actual knowledge will be established by receipt of a take town notice from the copyright owner in accordance with the prescribed notice and take down procedure. There are basic differences between the provisions in the US, EU and South Africa; however, all leave various issues unanswered. For instance, there is a general lack of guidance as to the meaning of 'expeditious' in relation to the removal of, and disabling access to content, and much of its interpretation remains unclear. In addition, the notice and take-down procedures show shortcomings and allow for abuse.[964] Amongst other things, concerns have been raises that the take down scheme

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[961] ECT Act, s 73(1). A Similar provision can be found in 17 USC § 512(a); Directive 2000/31/EC of the European Parliament and of the Council of 8 June 2000 on certain legal aspects of information society services, in particular electronic commerce, in the Internal Market [2000] OJ L 178/1 (E-Commerce Directive), art 12.
[962] Cook (n 733) 10.04.
[963] ECT Act, s 75. A similar provision can be found in art 14 of the E-Commerce Directive and 17 USC § 512(c).
[964] J Cobia, 'The Digital Millennium Copyright Act Takedown Notice Procedure: Misuses, Abuses and Shortcomings of the Process' (2009) 10(1) Minn JL Sci & Tech 387.

has been used to impede the exercise of copyright limitations and exceptions.[965] According to a public policy report

> [a] major force contributing to the erosion of fair use is the culture of gatekeeper-intermediaries […] who care less about legal niceties or the rights of users than about avoiding expensive lawsuits.[966]

Another important issue is the absence of any requirement of proof of the validity of the take down claim. The 'chilling effects' of such practise could have far-reaching consequences for online collaboration, and alternatives have been proposed.[967] Thus far, it appears that most platforms have incorporated DMCA requirements in their terms of use[968] and have complied with take down notices, mostly under the US DMCA.[969]

It is reasonable to assume that many design sharing platforms are indeed aware that their platforms are being used for hosting and disseminating infringing content. This raises questions as to the interpretation of the main imputed factors, particularly 'knowledge of infringement'. According to the ECT Act, in order to avoid liability, the hosting intermediary shall not

> have actual knowledge that the data message or an activity relating to the data message is infringing the rights of a third party; or [be] aware of facts or circumstances from which the infringing activity or the infringing nature of the data message is apparent.[970]

The relevant provisions in the E-Commerce Directive and DMCA are similar. However, actual knowledge is difficult to prove, and the discussion, therefore, turns

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[965] JM Urban and L Quilter, 'Efficient Process or "Chilling Effects" – Takedown Notices under Section 512 of the Digital Millennium Copyright Act' (2005) 22 Santa Clara Computer & High Tech LJ 621, 687.
[966] M Heins and T Beckles, 'Will Fair Use Survive?: Free Expression in the Age of Copyright Control' Brennan Center for Justice, Public Policy Report (2005), 55 <https://www.brennancenter.org/sites/default/files/publications/Will%20Fair%20Use%20Survive.pdf> accessed 30 November 2018.
[967] For instance, Rideout suggests increased community self-policing as an alternative to avoid likelihood of legal actions. Rideout (n 61) 176.
[968] See, for example, Makerbot, 'Makerbot Terms of Use' (17 October 2017), <https://www.makerbot.com/legal/terms> accessed 30 November 2018; Shapeways 'Shapeways Terms and Conditions' (7 February 2017) <https://www.shapeways.com/terms_and_conditions> accessed 30 November 2018.
[969] For instance, Thingiverse removed the designs of Tintin's cartoon moon rocket after receiving a take-down notice from Moulinstart, the copyright holder in the cartoon Tintin. See Henn (n 25). Shapeways also complied when it received a take-down notice from Katy Perry's lawyers against selling the Left Shark design. See Masnick (n 113).
[970] ECT Act, s 75(1).

to what constitutes constructive knowledge of infringement. In absence of South African case law, the laws of the EU and US, and their interpretation by the courts, may provide additional insight.

In the EU, the degree of knowledge or awareness has, for instance, been subject of court decisions in Germany. Broadly, the knowledge must refer to specific infringement, rather than general awareness that infringing content is present.[971] At least in Germany and the Netherlands, the test for awareness of facts or circumstances from which the illegal conduct would be apparent implies some kind of gross negligence.[972]

Looking at this issue from the US perspective, 'red flags' and wilful blindness are tantamount to actual knowledge. The 'red flag' standard has been held to be a high one.[973] In the words of Nimmer, the flag must be

> brightly red indeed - and be waving blatantly in the provider's face - to serve the statutory goal of making 'infringing activity […] apparent.[974]

The interpretation of 'wilful blindness' is equally restrictive. In *Viacom v Youtube*,[975] the court held that the blindness must relate to 'specific and identifiable infringements of specific items'.[976] However, more relevant case law is needed.

Despite being exempt from monetary liability for their users' actions, injunctions can be granted against these intermediaries. In *Scarlett v SABAM*,[977] the CJEU noted that these injunctions can be aimed not only at halting the occurring infringements, but preventing further infringements;[978] however, not to the extent that it would require a general obligation to monitor, which is prohibited by the Directive.[979] This does not prevent authorities from 'from imposing a monitoring

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[971] T Verbiest and others, (Study on the Liability of Internet Intermediaries' (Markt/2006/09/E, 2007), 36 <http://ec.europa.eu/internal_market/e-commerce/docs/study/liability/final_report_en.pdf> accessed 30 November 2018.
[972] ibid, 37.
[973] For an overview of the interpretation of the 'red flag' standard see J Wang, 'Development of Hosting ISP's Secondary Liability for Primary Copyright Infringement in China – as Compared to the US and German Routes' (2015) 46(3) IIC 275, 280–81.
[974] *Nimmer on Copyright* (LexisNexis 2003) 358
[975] *Viacom International v YouTube Inc*, 2010 WL 2532404, 3 (SDNY 2010).
[976] ibid, 32.
[977] Case C-70/10 *Scarlet Extended SA v Société belge des auteurs, compositeurs et éditeurs SCRL (SABAM)* [2011] ECR, I-11959.
[978] ibid [31].
[979] ibid [38].

obligation in a specific, clearly defined individual case.'[980] Blocking orders are permitted provided that such measures do not 'unnecessarily deprive internet users of the possibility of lawfully accessing information available'.[981]

5.4 – The Rights Overlap

Copyright plays a key role in protecting 3D printing subject matter. However, as has been shown in the previous chapters, other intellectual property regimes also apply.[982] The potential overlap between these rights raises significant questions as to the suitability of copyright protection for CAD models and means to limit the extent to which copyright can be used to protect subject matter that is not eligible for copyright protection.

5.4.1 – Copyright-Design

Both designs law and copyright apply to works of applied art and industrial design, and the protection offered under the registered design regime has the potential to overlap with the protection provided under copyright. The overlap between copyright and designs law arises in two distinct situations: The first situation is when copyright and designs law both protect the same subject matter. In particular, copyright subsists in artistic works that can be eligible for registered design protection, including sculptures, engravings and works of artistic craftsmanship.[983] The second situation entails the indirect copyright protection of works eligible for design protection through copyright in their design drawings. In this context, the potential overlap arises from the fact that the owner of the copyright in a two-dimensional artistic work has the exclusive right to reproduce the work in three-dimensional format.[984] For

[980] Commission, 'First Report on the Application of Directive 2000/31/EC of the European Parliament and of the Council of 8 June 2000 on Certain Legal Aspects of Information Society Services, in Particular Electronic Commerce, in the Internal Market (Directive on Electronic Commerce)' COM (2003) 702 final, 14.
[981] Case C-314/12 UPC *Telekabel Wien GmbH v Constantin Film Verleih GmbH* ECLI:EU:C:2014:192, [64].
[982] Chapters 2 – 4.
[983] Copyright Act, s 1(1), definition of 'artistic work'; CDPA, s 4(2).
[984] Copyright Act, s 1(1), definition of 'reproduction'; CDPA, s 17(2).

instance, a vase protected as a registered design could also be protected—indirectly—as an artistic work under copyright, based on the copyright in the drawing of the vase.

Traditionally, the indirect protection of designs has focused on preliminary 2D drawings that comprise the basis of the final article. 3D printing shifts the focus to 3D drawings—CAD models. As noted in this chapter, it is generally accepted that copyright subsists in CAD models.[985] Irrespective of the qualification of CAD models under copyright, the fact is that designs can receive protection under copyright law through their digital representation. In the context of 3D printing it becomes imperative to re-examine the potential overlap, in particular because digital and physical embodiments are separated by a mere few mouse clicks. A potential result is, for example, that while the design rights in a particular object may have expired, copyright in the respective CAD model could prevent the manufacturing of the product.

Different jurisdictions operate different models of design protection, and the extent to which copyright an designs law can be cumulative varies widely.[986] South African design law does not explicitly determine its relationship with copyright; however, it explicitly excludes designs that are not intended to be manufactured by an industrial process from its scope.[987] The Designs Act and Designs Regulations are silent on the definition of 'industrial process', and it remains unclear how it will be interpreted in relation to 3D printing. In fact, the decentralised nature of 3D printing makes it difficult to establish the extent of actual materialisation, thus manufacturing, of the underlying design.

European designs law establishes the principle of cumulation with copyright law,[988] and Member States can provide copyright protection for designs protected under the Community Designs Regulation and the Designs Directive.[989] Regardless of their approach, utilitarian items can nonetheless obtain copyright protection via the

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[985] See 5.2.1 – Qualification.
[986] A Kingsbury, 'New Zealand Designs Law: The Case for Reform' (2009) 3 IPQ 345, 348–68.
[987] Designs Act, s 14(4).
[988] See Community Design Regulation, recital 32 and art 96(2); Design Directive, recital 8 and art 17.
[989] To the extent the national requirements for copyright are fulfilled. In absence of complete harmonisation of copyright, Member States establish the extent of copyright protection and the conditions under which such protection is conferred. As a result countries have drawn the line between designs and copyright through a wide plethora of approaches. France, for example, allowed for cumulation of copyright and design rights, the so-called perfect cumulation approach. to a higher standard for protection, leading to the partial cumulation approach. See Margoni (n 439) [59]–[62].

design drawing—the three-dimensional reproduction of which amounts to direct infringement.

Section 51(1) of the UK CDPA aims to exclude the field of functional industrial designs from copyright. This provision states:

> it is not an infringement of any copyright in a design document or model recording or embodying a design for anything other than an artistic work or a typeface to make an article to the design or to copy an article to the design.

It is generally accepted that the definition of 'design documents'[990] includes CAD models.[991] Consequently, the materialisation[992] of CAD models of an object other than an artistic work does not infringe the copyright in that model.[993] In as far as copyright is concerned, these legally made physical objects can subsequently be issued to the public,[994] but the reproduction of the initial CAD model as such remains an act of infringement. In these cases, however, there may be an infringement of the respective design rights, be it registered or unregistered.[995]

5.4.2 – Copyright-Patent

Traditionally, there has been no overlap between copyright and patents for the reason that there is a clear divide between the subject matter protected under the two respective intellectual property regimes. This orthodoxy has led literature to neglect the potential overlap that arises within the context of 3D printing, in particular as a result of the digitisation of objects which includes additional information on the geometrical shape, including material use. This work argues, perhaps controversially, that there is an overlap between copyright and patents, albeit indirect.

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[990] 'Design document' means any record of a design, whether in the form of a drawing, a written description, a photograph, data stored in a computer or otherwise. CDPA, s 51(3).
[991] See, Mendis (n 18). The same applies to CAD models qualified as a computer programmes.
[992] And the later issuing to the public thereof. CDPA, s 51(2).
[993] 'Design' means the design of any aspect of the shape or configuration (whether internal or external) of the whole or part of an article, other than surface decoration. CDPA, s 51(3).
[994] CDPA, s 51(2).
[995] Section s 51 initially only applied to *functional* designs protected under the unregistered designs regime. The overlap between *aeshtic registered* designs and copyright was primarily regulated by section 52. However, with the harmononisation of the scope of registered designs on the EU-level, section 51 now has increased application in cases relating to registered design rights.

Materialisation connects copyright to the patent sphere. In the physical environment, copyright and patent law protect different subject matter; however, digitisation causes a situation where copyright protects the digital embodiments of potentially patentable subject matter. The subsequent materialisation of a digital model of an invention is generally only separated by a few, generally effortless, actions. This said, it is imperative that the distinct scope of the two protection regimes is emphasised: Copyright in the CAD models protects the visual aspects of the underlying objects, while patent law protects the functionality of that object. The result is that copyright only overlaps with patent law when the visual elements of the object hold, or are dictated by, its utilitarian function. In other words, a 3D printable patented invention, for example a mechanical closing system, could be represented as a digital model, and, after being materialised, fulfil its functional purpose. This raises similar issues as to functional designs under the copyright-designs overlap, as discussed above. An exception to exclude from copyright infringement the making of a patented invention to a copyright protected CAD model is, however, absent.

5.5 – Conclusion

This chapter has shown that copyright is the main form of protection for 3D printing subject matter; however, the protection of CAD models through copyright raises various issues regarding applicability, enforcement, liability of platforms and rights overlap. And while there remains uncertainty as to the legal status of CAD models and the extent to which models created through 3D replication software can be deemed original, it is not disputed that CAD models qualify, in principle, for copyright protection. One problematic issue, however, is that copyright in digital models can be used to protect objects that would otherwise fall outside of its scope, with potentially detrimental consequences for society. The role of limitations, exceptions and defences is therefore imperative; not only to limit the reach of copyright, but to generally facilitate the 3D printing process. From a user perspective, the protection of CAD models through copyright law together with the absence of sufficient limitations and exceptions poses barriers for use, collaboration and follow-on creation. Means to mitigate this problem, for example through the use of open source licences, are discussed in the following chapter.

Chapter Six
Responding to Consumer 3D Printing

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'the lesson of the music industry is that whether you fight change or not, it doesn't stop it happening. It just means that someone else becomes the agent of change'[996]

6.1 – Introduction

It is generally accepted that intellectual property rights incentivise creativity and innovation.[997] While much creativity and innovation within the consumer 3D printing ecosystems happens regardless of any monetary intellectual property incentive,[998] the protection and economic exploitation of intellectual property remains a significant impetus for many rights holders. As consumer 3D printing expands into various industries, it appears likely that the incumbents will heavily rely on intellectual property protection and enforcement to protect their business and prevent competition. This group of rights holders—owners of intellectual property-based objects that are capable of being 3D printed—is the subject of this chapter.

Control is key for ensuring that rights holders are remunerated, and the law and other protection measures should prevent the unauthorised use and dissemination of protected works. Digitisation, however, makes control over content increasingly

[996] M Weinberg, 'It Will Be Awesome if They Don't Screw It Up: 3D Printing, Intellectual Property, and the Fight Over the Next Great Disruptive Technology', Whitepaper from Public Knowledge (2010) <https://www.publicknowledge.org/files/docs/3DPrintingPaperPublicKnowledge.pdf> accessed 30 November 2018.

[997] Incentive-based theories are one of copyright justifications. See Bently and Sherman (n 474) 37–38; W Gordon, 'An Inquiry into the Merits of Copyright: The Challenges of Consistency, Consent and Encouragement Theory' (1989) 41 Stanford L Rev 1343. See also Marrakesh Treaty to Facilitate Access to Published Works for Persons Who Are Blind, Visually Impaired or Otherwise Print Disabled of June 2013, recital 3 ('Emphasizing the importance of copyright protection as an incentive and reward for literary and artistic creations […]').

[998] 1.2 – The Consumer 3D Printing Market. Many digital models are licensed under free and open licensing regimes, such as Creative Commons. In fact, the majority of models on Thingiverse are made available under the most open Creative Commons licences. Moilanen and other (n 80) 17, table 2.

difficult.[999] This is but one reason why some scholars argue that the emergence of new technological dissemination methods might justify not only granting stronger protection for digital content, but a higher degree of control through various enforcement tools.[1000] Indeed, in the context of 3D printing, the public availability of digital designs means, for the rights holders, a significant loss of control over the source file, and the subsequent produced object.[1001]

This chapter discusses the means available to rights holders to remain control over their intellectual property rights in the era of increased digitisation. This discussion is grounded in the dynamics of the current consumer 3D printing ecosystem, and based on the premise of the availability of the design file.[1002] In particular, it shows how attempting to control intellectual property rights various measures affect the creative and operational dynamics within the consumer 3D printing community, which ultimately determine the efficacy and success of consumer 3D printing market.

Considering these effects together with the dynamics within the current consumer 3D printing ecosystem, it explores various approaches to promote the optimal utilisation of the current consumer ecosystem through the making available of digital models. This exploration starts with a survey of the current system of licensing. Particular focus is on open source licensing, which has driven the development of the consumer 3D printing market

It then goes on to analyse potential approaches for rights holders to respond to this emerging technology, in particular approaches towards design dissemination, co-creation and peer production, and intellectual property infringement. This chapter concludes by examining the complex dynamic between various right holder-based approaches.

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[999] See Committee on Intellectual Property Rights, Computer Science & Telecommunications Board (n 2) 3-6.
[1000] JC Ginsburg, 'Copyright and Control Over New Technologies of Dissemination' (2001) 101 Columb L Rev 1613.
[1001] 1.5.1 – Digital Distribution.
[1002] The threat for rights holders lies in the dissemination of digital design files, either authorised or unauthorised. It does not consider the legality of the file itself.

6.2 – Controlling Intellectual Property Rights

6.2.1 – Education

> You wouldn't download a car.[1003]

Online piracy is characterised by a 'morality gap':[1004] The general public does often not perceive the copying of digital content as wrongdoing,[1005] let alone stealing or theft.[1006] Reasons for this arguably include the lack of guidance for online behaviour, and the fact that there is no immediately recognisable 'victim' or 'crime'.[1007] It is believed, therefore, that any effort to control intellectual property rights should be preceded and supplemented by campaigns to educate people on the legality and morality[1008] of their digital uses and the civil or criminal sanctions involved.[1009] In the words of one commentator 'prevention through education is preferable to the "cure" of litigation.'[1010] However, at least for the music industry, many of the 'educational' campaigns launched against illegal downloading proved unsuccessful.[1011] Mere education did not seem to change user perception and online behaviour;[1012] and although over the last years the number of illegal downloads appears to have

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[1003] This parody on the famous MPAA campaign 'You wouldn't steal a car. You wouldn't steal a handbag. You wouldn't steal a television. You wouldn't steal a movie. Downloading pirated films is stealing, stealing is against the law, PIRACY. IT'S A CRIME.' is becoming increasingly applicable in the 3D printing environment.

[1004] Compared to the physical world.

[1005] T O'Flynn, 'File-sharing: an Holistic Approach to the Problem' (2006) 17(7) Ent L Rev 218, 219–221; R Piasentin 'Unlawful? Innovative? Unstoppable? A Comparative Analysis of the Potential Legal Liability Facing P2P End-Users in the United States, United Kingdom and Canada' [2006] IJLIT 195, 212-213. See also Strategic Advisory Board for Intellectual Property Policy, 'Copycats? Digital consumers in the online age' (2009) <https://www.kl.nl/wp-content/uploads/2014/04/a8ea9001-9376-4478-9506-6bc889065215> accessed 30 November 2018.

[1006] The terms 'theft' and 'stealing' are extensively used by lobby groups consisting of or funded by copyright owners in anti-piracy advertising campaigns and are sometimes. P Loughlan,'"You Wouldn't Steal a Car ...": Intellectual Property and the Language of Theft' (2007) 29(10) EIPR 401, 404.

[1007] Strategic Advisory Board for Intellectual Property Policy (n 1005) 14–15.

[1008] In some countries, this might involve a consideration of digital piracy to be of immoral from a religious perspective. See S Al-Rafee and K Rouibah, 'The Fight Against Digital Piracy: An Experiment' (2010) 27 Telematics and Informatics 283.

[1009] S Yavorsky, 'Copyright - Music - Piracy and File-sharing' (2006) 17(3) Ent L R N23. See also Committee on Intellectual Property Rights, Computer Science & Telecommunications Board (n 2) 16.

[1010] O'Flynn (n 1005) 221.

[1011] For instance, the MPAA campaign which compared copyright infringement to physical theft became a source of ridicule and parody. See also Yavorsky (n 1009).

[1012] Deterrence strategies might work for some users, but may increase piracy tendencies in others. S Taylor, C Ishida and D Wallace, 'Intention to Engage in Digital Piracy: A Conceptual Model and Empirical Test' (2009) 11(3) Journal of Service Research 246, 255. See also RK Sinha and N Mandel, 'Preventing Digital Music Piracy: The Carrot or the Stick' (2008) 72(1) Journal of Marketing 1.

decreased,[1013] this is arguably the result of the shift to streaming models—legal and illegal—rather than effective education.[1014]

Until now, no similar campaigns against illegal sharing of digital models for 3D printing have been launched.

6.2.2 – Legal Enforcement

> The cost of enforcement against each individual […] will generally outweigh the value of any relief of recovery.[1015]

6.2.2.1 – Cease and Desist (including Notice and Take Down) – Cease and desist letters inform a party of its alleged infringing activities, and demand that these activities be stopped immediately and permanently—generally under the threat of legal action. From a rights holders' perspective the cease and desist process is considered to be an effective tool[1016] and potential infringers are likely to comply without judicial intervention.[1017] Even if the alleged infringer is not liable at the time of infringement, the letter could suffice to impute the knowledge and intent necessary for indirect infringement.

In the context of copyright, rights holders can typically rely on numerous enforcement tools, and the US DMCA can serve as an example here.[1018] File sharing services may rely on safe harbour provisions to avoid liability in exchange for implementing notice and take down procedures. However, not every cease and desist letter qualifies as a take down notice in accordance with the DMCA, and specific

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[1013] Between 2014 and 2017 the amount of illegal downloads in Europe has decreased (with the exception or Germany). Institute for Information Law, 'Global Online Piracy Study' (July 2008) 50–52 <https://www.ivir.nl/publicaties/download/Global-Online-Piracy-Study.pdf> accessed 30 November 2018.

[1014] Streaming has been the channel most commonly used to access digital music in Europe during the period 2014–2017. ibid. 47–48, 51.

[1015] Brean (n 594) 786.

[1016] They could open licensing negotiations or serve as a warning.

[1017] LC Grinwald,' Policing the Cease-and-Desist Letter' (2015) 49(3) USF L Rev 411. In relation to trade marks, R Braswell, 'Consumer Gripe Sites, Intellectual Property Law, and the Use of Cease-and-Desist Letters to Chill Protected Speech on the Internet' (2006-2007) 17 Fordham Intell Prop Media & Ent LJ 1241, 1282*;* PA Levy, 'The Trademark Dilution Revision Act - A Consumer Perspective' (2006) 16 Fordham Intell Prop Media & Ent LJ 1189, 1200.

[1018] In this section, we discuss the DMCA because most service providers comply with US law.

conditions determine the validity of the notice.[1019] In the last few years the number of take down notices against users and file sharing platforms has increased, provoking strong reactions.[1020] While the procedure often leads to the removal of the work in dispute, it can lead to an endless game of Whack-a-Mole[1021] which can be extremely costly and time consuming. From a user perspective, notice and take down could have significant chilling effects on the use of 3D printing, which will be discussed below.[1022]

Most design sharing platforms already adopt an extensive notice and take down procedure.[1023] They implement take down procedures for content based not only on copyright claims, but various other regimes, including the law of patents, designs, and trade marks. Indeed, as the previous chapters have established, these intellectual property regimes apply (often simultaneously) to digital models.[1024] With the exception of copyright, however, the implementation of these broad take down procedures does not exclude them from liability under the DMCA safe harbour provisions which solely apply to copyright infringement.[1025] Several commentators have therefore argued for the enactment of a notice and take down procedure for patents and trade marks similar to the DMCA and coupled with safe harbour provisions.[1026] A similar argument can be made for design rights. However, the analogous application to ISPs in relation to patents, designs and trade marks is challenging. The nature of infringement differs as most copyright infringement occurs verbatim, while the analysis for trade mark, patent and design infringement might

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[1019] This part of the work focusses on the DMCA for the reasons that most file sharing platforms comply with US legislation.
[1020] See supra note 113.
[1021] Whack-a-Mole is 'an arcade game in which imitation moles continuously pop up from different holes at random, and players attempt to hit them with a mallet.' 'whack-a-mole, n' (*OED Online*, OUP December 2018) <https://www.oed.com/view/Entry/390603> accessed 30 November 2018. These toy moles generally re-appear faster than one is able to hit them. In the legal field, this term is used figuratively to denote 'to a problem which is addressed in a piecemeal or superficial manner, resulting merely in temporary, minor, or localized improvement, or to a situation in which problems continually or unpredictably arise.' 'whack-a-mole, n' (*OED Online*, OUP December 2018) <https://www.oed.com/view/Entry/390603> accessed 30 November 2018.
[1022] 6.2.2.3 – Chilling Effects.
[1023] See, for instance, the notice and take down procedure of Thingiverse and Shapeways. Thingiverse, 'Thingiverse Removal Wizard', <https://www.thingiverse.com/legal/dmca> accessed 30 November 2018; Shapeways, 'Shapeways Content Policy and Notice Takedown Procedure <https://www.shapeways.com/legal/content_policy> accessed 30 November 2018.
[1024] Chapters 2–5.
[1025] 5.3.5 – Safe Harbours.
[1026] Davis (n 10) 365-68; Desai and Magliocca (n 1144) 1718–19; DH Brean, 'Patenting Physibles: A Fresh Perspective for Claiming 3D-Printable Products' (2015) 55 Santa Clare L Rev 837, 860–863.

prove more difficult.[1027] Commentators also refer to the scale of the infringement, which is significantly smaller in relation to patents, and the fact that intermediaries might be liable for direct, rather than indirect, infringement.[1028] Notably, the South African ECT Act applies to 'data' rather than copyright materials, and it can therefore be argued that its safe harbour provisions could apply to trade marks and designs.

6.2.2.2 – Legal Action – Another strategy for controlling intellectual property rights is suing infringers, both users and intermediaries. Although litigation has often been relied upon by the entertainment industry in the past, no consumer 3D printing related litigation has taken place thus far.[1029] In the past, an essential part of the rights holders' strategy against file-sharing consisted of legal action against individual users.[1030] However, this approach is considered costly, ineffective and counterproductive as it potentially damages consumer relationships and public relations.[1031] At least in the music sector litigation against users also did not seem to have the desired deterrent effect, and increased enforcement can therefore not be regarded as a viable long-term business strategy to curb infringement.[1032] In addition, increased enforcement is likely to have negative effect on the public perception, which could lead to a decrease in public support for the right rights holders seek to protect. Individual infringement also poses several enforcement issues, including:

- Detection of infringement;[1033]
- Identification and location of infringers;[1034]
- Easy access to unauthorised files leads to potential mass infringement; and
- Cross-border legal problems.[1035]

[1027] Osborn (n 21) 588; Doherty 368.
[1028] Osborn (n 21) 588. Regarding the scope of patent infringement in the context of consumer 3D printing see 4.1.1 – Patent Law.
[1029] In the jurisduction discussed.
[1030] O'Flynn (n 1005) 218–19.
[1031] Holbrook and Osborn (n 598) 1333, B Depoorter 'Intellectual Property Infringements & 3D printing: Decentralized piracy' (2013-14) 65 Hastings Law Journal 1483; Lemley (n 15) 499–502.
[1032] Institute for Research on Private Law, 'Peer-to-peer File-sharing and Literary and Artistic Property - A Feasibility Study Regarding a System of Compensation for the Exchange of Works Via the Internet' (June 2005), 10-11 <http://privatkopie.net/files/Feasibility-Study-p2p-acs_Nantes.pdf> accessed 30 November 2018.
[1033] Including the dissemination of design file, but particularly the physical manufacturing.
[1034] Seen the largely anonymous nature of internet access. C Nasir, 'From Scare Tactics to Surcharges and Other Ideas: Potential Solutions to Peer to Peer Copyright Infringement: Part 3' (2005) 16(5) Ent L R 105, 105.

Many of the same arguments against employing a litigation strategy would apply, it seems, in the context of 3D printing services.

Litigation against intermediaries is likely to be aimed at design sharing platforms.[1036] It has been established in the previous chapters that intermediary liability for design sharing platforms in the digital environment is uncertain, in particular relating to the law of patents and designs.[1037] However, their compliance with notice and take down procedures, such as those contained in the DMCA, diminishes the need for legal action and, at least for copyright, protects these platforms from liability.

It must be emphasised that once design file sharing moves to P2P file sharing platforms, it will become increasingly difficult to enforce rights. Unlike the current design sharing platforms, P2P networks rely on the decentralised storage of the source file.[1038] Attempts to shut down P2P file sharing platforms have thus far been largely unsuccessful as platforms just relocate to other, 'more tolerant' jurisdictions, or other platforms take their place.[1039]

6.2.2.3 – Chilling Effects – Legal enforcement could thwart creation and dissemination of designs, particularly the notice and take down system under, for example, the DMCA.[1040] Empirical research shows that the current system is susceptible to mistakes and abuse.[1041] The lack of judicial or quasi- judicial oversight, and fear of liability by intermediaries could lead to the unwarranted removal of non-infringing content. The inaccuracy of automated take downs further aggravates the issue of unjustified removals by raising false-positives.[1042] The application of the

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[1035] ibid, 105–06
[1036] The legal argument against 3D printing hardware manufacturers is weak.
[1037] For instance, 3.4.1 – Equating CAD models to Physical Goods; 4.2.1 – Equating CAD Models to Physical Objects; 4.2.2 – CAD Models as Enablers of Infringement.
[1038] 1.2.2.4 – Peer-to-Peer File Sharing Services.
[1039] For instance, the Pirate Bay's relocation and decentralisation of its servers. See M Li, 'The Pirate Party and the Pirate Bay: How the Pirate Bay Influences Sweden and International Copyright Relations' (2009) 21 Pace International Law Review 281, 288–9. See also Fung and Lakhani (n 93).
[1040] Or its equivalent.
[1041] JM Urban, J Karaganis and BL Schofield, 'Notice and Takedown in Everyday Practice', UC Berkeley Public Law Research Paper No. 2755628, version 2 (March 2017) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2755628> accessed 30 November 2018.
[1042] See 6.2.3 – Technological Protection Tools.

take down system not only affects hosting websites, but creators and their willingness to create and share.[1043]

6.2.3 – Technological Protection Tools

> Technical protection tools include a wide variety of software- and hardware-based mechanisms that limit access to or use of information.[1044]

Intangible content cannot be controlled through physical means. Proponents of technological protection tools argue that such tools are essential for meaningful control of the dissemination of content in the digital environment. It is, however, highly simplistic to expect technology to understand the complexity of the intellectual property system.[1045] The technological approach also poses a risk to users by compromising their ability to legitimately access and use works and must be addressed with caution. Irrespective of their potential to mitigate the lack of control faced by rights holders, technological tools raise numerous practical problems. While technological solutions are gaining interest in the 3D printing market,[1046] uncertainty remains as to whether technical means can be applied to the digital models, and the introduction of anti-circumvention provisions, as discussed below, already confirms the precarious status of most technical 'solutions' when it comes to effectiveness. The creation, application and promotion of technological protection tools ultimately appears to be an expensive temporary deterrent or tool rather than a panacea.[1047]

[1043] Anecdotal evidence suggests that the process could detrimentally affect creators' willingness to create and share. For example, after his design was taken down from Thingiverse after a DMCA takedown notice, one designer stated: 'The DMCA knocked the wind out of me. I haven't uploaded many of my printable models since it happened'. Thompson (n 113).

[1044] Committee on Intellectual Property Rights, Computer Science & Telecommunications Board (n 2) 12.

[1045] And, for example, decide when a use is permitted under copyright limitations and exceptions. C Clark, 'The Answer to the Machine is in the Machine' in PB Hugenholtz (ed), *The Future of Copyright in a Digital Environment* (Kluwer 1996) 145.

[1046] C Farivar, 'Worried About Accidentally 3D Printing a Gun? New Software Will Prevent It' (*Ars Technica,* 26 June 2013) < https://arstechnica.com/information-technology/2013/06/worried-about-accidentally-3d-printing-a-gun-new-software-will-prevent-it> accessed 30 November 2018; R Park, 'Will Things3D Unlock the Huge Potential of Consumer 3D Printing? Very Possibly!' (*3D Printing Industry,* 16 July 2014) < https://3dprintingindustry.com/news/will-things3d-unlock-huge-potential-consumer-3d-printing-possibly-29889> accessed 30 November 2018. Many commentators also refer to the patent application by Intellectual Ventures that cover a process that would scan all incoming files for potential infringement. However, it should be noted that Intellectual Ventures is known to be a notorious troll firm.

[1047] Committee on Intellectual Property Rights, Computer Science & Telecommunications Board (n 2).

The following sections discuss technological protection through digital rights management, anti-circumvention measures, monitoring and distributed ledger technology.

6.2.3.1 – Digital Rights Management – Digital Rights Management (DRM) systems consists of end-user license agreements (EULAs), rights management information (RMI) and Technological Protection Measures (TPMs). The rhetoric surrounding DRM is often associated with TPMs restricting use and inhibiting creativity and innovation.[1048] Their legal recognition and regulation has been introduced by the WIPO Treaties,[1049] the EU Copyright Directive,[1050] and many national legal systems.[1051] The circumvention of TPMs and the supplying of means for such circumvention often constitutes an offence.[1052] TPMs could substantially restrict public access to works and could lead a 'digital lock-up' of material,[1053] including preventing access to, and copying of, non-copyrightable information and materials in the public domain.[1054] It also can impose further limitations to use of the material, such as the amount of times the material can be accessed and used.

Theoretically, TPMs provide a system for distributing content without losing the ability to control,[1055] which may permit the dissemination of material that the

[1048] Amongst other things, DRM is held to undermine copyright limitations and exceptions. JE Cohen, 'Lochner in Cyberspace: The New Economic Orthodoxy of "Rights Management"' (1998) 97 Michigan Law Review 462, 472-73; KJ Koelman and N Helberger, 'Protection of Technological Measures' in PB Hugenholtz (ed), *Copyright and Electronic Commerce – Legal Aspects of Electronic Copyright Management* (Kluwer 2000) 189–92. It is further held that TPMs unduly extend intellectual property protection. Lessig (2001).
[1049] WCT, art 11; WPPT, art 18.
[1050] Copyright Directive, arts 6–7.
[1051] For instance, ECT Act, s 86(3).
[1052] Infra 6.2.3.2 – Anti-circumvention.
[1053] Assuming they were effective.
[1054] See DL Burke and JE Cohen 'Fair Use Infrastructure for Rights Management Systems' (2001) 15(1) Harv J Law & Tec 41; S Bechtold, 'The Present and Future of Digital Rights Management – Musings on Emerging Legal Problems' in E Becker and others *Digital Rights Management – Technological, Economic, Legal and Policitcal Aspects,* (Springer-Verlag 2003) 589-654; A Ottolia, 'Preserving Users' Rights in DRM: Dealing with "Juridical Particularism" in the Information Society' (2004) 35(5) ICC 491; F von Lohmann, 'Fair Use and Digital Rights Management: Preliminary Thoughts on the (Irreconcilable?) Tension Between Them' (EFF) <w2.eff.org/IP/DRM/fair_use_and_drm.html> accessed 30 November 2018.
[1055] TPM have generally been used on digital content. However, 3D scanning open the gateway to mass infringement by enabling the digitisation of physical objects. There have been a lot of rumours and expectations about the implementation of anti-scanning systems, which potentially could prevent people from 3D scanning certain objects; however, at present, there remains significant uncertainty as to the effectiveness and implementation of this technology.

right holder world normally be reluctant to release.[1056] However, their application is limited by technical and practical weaknesses; they are particularly ineffective in that they can be easily circumvented.[1057] In relation to digital files, TPMs must be applied universally considering a single unprotected file could be multiplied exponentially, nullifying the TPMs applied to other versions of the file.[1058] Similarly, TPMs on the hardware level, where 3D printers would check if the design has been authorized for use, [1059] would require cooperation from all hardware manufacturers to ensure effectiveness. On the hardware level, 3D printer manufacturers have imposed feedstock restrictions to their machines by installing a security chip in the cartridges—a technique often used for traditional printers—thereby significantly impeding consumer use. [1060] Irrespective of whether TPMs are technologically practicable,[1061] many creators within the consumer 3D printing community adhere to an open source ethic when it comes to design files which conflicts with strong intellectual property rights protection through employing TPMs.[1062] Overreliance on TPMs in this field will therefore likely alienate community members when faced with use restrictions, material incompatibility and the potential unavailability of hardware.[1063]

In spite of these concerns regarding the efficacy of TPMs, DRM systems arguably remain a *sine qua non* for most customer-based innovation.[1064] In fact, a DRM system consisting of balanced and clear EULAs and RMI provides a solution to

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[1056] Committee on Intellectual Property Rights, Computer Science & Telecommunications Board (n 2) 7–8.
[1057] For instance, DRM applied to 3D printer filament is often easy to circumvent. See B Benchhoff, 'Hacking Chipped 3D Printer Filament on The Da Vinci Printer' (*Hackaday Blog,* 12 January 2016) <https://hackaday.com/2016/01/12/hacking-chipped-3d-printer-filament-on-the-da-vinci-printer> accessed 30 November 2018
[1058] DRM is normally not applied to the unauthorised files shared over the internet.
[1059] For example, only printing designs files obtained from legitimate sources.
[1060] For instance, Stratasys and XYZ Printing.
[1061] Many commentators refer to the patent application by Intellectual Ventures that cover a process that would scan all incoming files for potential infringement. However, it should be noted that Intellectual Ventures is known to be a notorious troll firm.
[1062] 1.2 – The Consumer 3D Printing Market. Consumers perceived DRM as unreasonable and restrictive when applied to digital music. See A Murray, *Information Technology Law: The Law and Society* (OUP 2010) 69–70.
[1063] For example, in 2016, 3D Systems abandoned its consumer Cube printers which were designed to only accept proprietary filament. The result is that when 3D Systems also discontinued the production of the Cube filament, users would no longer be able to buy filament for their device. M Weinberg, 'Free the Cube' (*Michael Weinberg Blog,* 10 January 2016) <http://michaelweinberg.org/post/137045828005/free-the-cube> accessed 30 November 2018.
[1064] Bechtold (n 1054); de Beer (n 174) 289.

facilitate a system of follow-on creation and peer-production within the boundaries of the intellectual property system.[1065] In the digital environment, information that facilitates the identification of the work, rights holder, or managing rights can be attached permanently, invisibly and indelibly.[1066] Out of concerns that such rights management information could be modified or erased, the WCT and WPPT introduced—in their respective fields—a provision for the protection of rights management information. And the European Commission regards such protection as a pre-requisite for an effective 'information society'.[1067]

The most well-known example of providing balances and clear EULAs and RMI, the Creative Commons licensing scheme, is discussed below.[1068]

6.2.3.2 – Anti-circumvention – There is already a fear that extensive application of DRMs, especially TPMs could, lead to digital lock-up of works. In addition, the WCT [1069] and WPPT [1070] now require 'adequate legal protection' against the circumvention of 'effective technological measures'. A number of domestic laws already implemented such protection, including South Africa and the UK.[1071] The effects of such anti-circumvention provisions are unprecedented and far-reaching. Effectively, they solidify—predominantly in the area of copyright law—the technological protection of works, effectively superseding copyright and undermining copyright limitations and exceptions. While the CDPA provides for exceptions to the prohibition on circumvention, the prohibition under the South African ECT Act is absolute with the result that materials can effectively be locked-up.[1072]

[1065] For instance, for rights holders to make their works available for follow-on creation, it is imperative that this information, including their respective permissions, are known to other creators.
[1066] S Dusollier, 'Some Reflections on Copyright Management Information and Moral Rights' (2003) 25 Colum JL & Arts 377, 379–81.
[1067] Commission (EC), 'Commission Staff Working Paper - Digital Rights: Background Systems, Assessment (14 February 2002) SEC (2002), 197. See also Benty and Sherman (n 474) 367.
[1068] 6.3.2.1 – Creative Commons. Acknowledgements
[1069] WCT, art 11.
[1070] WPPT, art 18.
[1071] ECT Act, s 86; CDPA, s 296ZB.
[1072] C Visser, 'Technological Protection Measures: South Africa Goes Overboard. Overbroad' (2006) 7(1) SAJIC 54. One reason for this absolute protection is that the ECT Act addresses circumvention together with other conduct such as hacking and other cybercrimes. It should be noted that the Copyright Bill, when in force the *lex specialis*, provides that circumvention may be carried out for purposes, such as permitted under the copyright exceptions. Copyright Bill, s 28P <https://libguides.wits.ac.za/ld.php?content_id=45613747> accessed 30 November 3018.

It has been suggested that the anti-circumvention provisions are being abused—and are likely to be abused in the future, too.[1073] Like technological protection measures, anti-circumvention legislation does typically not consider the balancing of rights and neglect the public interest embedded in the intellectual property rights system. The application of these so-called 'digital locks' has a profound impact on consumer use of 3D printers. They are applied to 3D printing hardware and prevent users from using third party filament, which is often cheaper and thus important from an accessibility perspective.

> Interoperability, innovation, and consumer value are all negatively impacted by manufacturer-imposed feedstock restrictions in 3D printers.[1074]

Attempts to mitigate these hardware restrictions have arguably be successful. In the US, in connection with the sixth triennial rulemaking proceeding under the DMCA, Public Knowledge, a public interest group, proposed to exempt from DMCA liability the circumvention of TPMs controlling access to firmware and software in 3D printers in order to allow for the use of non-manufacturer-approved materials[1075]. The US Copyright Office granted a three-year, expiring exception allowing 3D printer owners to circumvent the DRM on their devices:[1076]

> Computer programs that operate 3D printers that employ microchip-reliant technological measures to limit the use of feedstock, when circumvention is accomplished solely for the purpose of using alternative feedstock and not for the purpose of accessing design software, design files or proprietary data […].[1077]

[1073] DL Burke, 'Anticircumvention Misuse' 50 (2002-2003) UCLA L Rev 1095.
[1074] Public Knowledge, 'Petition for a Proposed Exemption under 17 USC 1201, in the Matter of Exemption to Prohibition on Circumvention of Copyright Protection Systems for Access Control Technologies' (3 November 2014), 4 <http://copyright.gov/1201/2014/petitions/Public_Knowledge_2_1201_Initial_Submission_2014.pdf> accessed 30 November 2018
[1075] Petition for a Proposed Exemption Under 17 U.S.C. § 1201 of Public Knowledge, In the Matter of Exemption to Prohibition on Circumvention of Copyright Protection Systems for Access Control Technologies, Docket No. RM 2014-07 (3 November 2014); Long Comment Regarding a Proposed Exemption Under 17 U.S.C. § 1201 of Public Knowledge and the Library Copyright Alliance, In the Matter of Exemption to Prohibition on Circumvention of Copyright Protection Systems for Access Control Technologies, Docket No. RM 2014-07 (6 February 2015).
[1076] Library of Congress, Exemption to Prohibition on Circumvention of Copyright Protection Systems for Access Control Technologies, 37 CFR Part 201, Docket No. 2014-07 <https://copyright.gov/1201/2015/fedreg-publicinspectionFR.pdf> accessed 30 November 2018.
[1077] ibid, 58.

The exception is subject to limitations,[1078] which according to many public interest advocates effectively nullify the exception.[1079] Apart from this 3D printing-specific intervention, proposals have been put forward to bring anti-circumvention regulations in line with copyright limitations and exceptions.[1080]

6.2.3.3 – Monitoring – Monitoring can be approached from two perspectives: user monitoring, and dissemination monitoring. On the one hand, DRM services allow for the monitoring of the end use by the users in order to ensure legal compliance by assigning a digital identifier to the content or content player. However, there is a real concern that DRM systems are being misused for other purposes, such as to profile users.[1081] On the other hand, rights holders can monitor the dissemination of their content either directly or indirectly. Direct monitoring involves the manual scanning of sharing websites and networks by the right holder or his agents, while indirect monitoring relies on detection through the use of WebCrawlers[1082] and the databases of digital fingerprints. While the latest software can detect of audio and video files, indirect monitoring is rather inaccurate as it still produces many false-positive and false-negative results.[1083] It remains unclear to what extent technology will be able to detect digital design files. Considering the technological difficulties in automated scanning, direct monitoring seems the most accurate way to monitor the dissemination of CAD models. However, this process is time consuming and not cost effective.

[1078] 'The exemption shall not extend to any computer program on a 3D printer that produces goods or materials for use in commerce the physical production of which is subject to legal or regulatory oversight…'. ibid.

[1079] Weinberg, for instance, argues that the exception applies to almost any 3D printer, as most printers are capable of producing things that can be sold commercially, and the production of these goods is subject to tort law. M Weinberg 'Unlocking 3D Printers Ruling Is a Mess' (*Michael Weinberg Blog*, 27 October 2015) <http://michaelweinberg.org/post/132021560865/unlocking-3d-printers-ruling-is-a-mess> accessed 30 November 2018; D Harris, What the Library of Congress Decided This Week About 3D Printing (*Public Knowledge Blog*, 30 October 2015) <https://www.publicknowledge.org/news-blog/blogs/what-the-library-of-congress-decided-this-week-about-3d-printing> accessed 30 November 2018.

[1080] Burk and Cohen (n 1054); Burk (n 1073).

[1081] C Sellars, 'Digital Rights Management Systems: Recent European Issues' (2003) 14(1) Ent L R 5, 9.

[1082] Softwares that methodically scans the internet collecting data to create an index of the data it is set to look for.

[1083] B Depoorter and R Walker, 'Copyright False Positives' (2013) 89 Notre Dame L Rev 319.

One far-reaching alternative is to increase the monitoring responsibilities of ISPs. A general monitoring obligation is prohibited,[1084] and as long as they comply with take-down notice, services that host UGC are not liable for the content on their platform.[1085] However, trends to assign ISPs a more 'active-preventative' role rather than a 'passive-reactive' role have increasingly blurred the scope of ISP obligations.[1086] Most importantly, a recent copyright proposal in the EU imposes on ISPs that hosts user-generated content to use 'effective content recognition technologies',[1087] which according to commentators equates to a general monitoring obligation.[1088] Although file sharing providers currently have the ability to monitor illegal music and video files,[1089] it is unclear to what extent such a technological control can be applied to design file sharing platforms.

6.2.3.4 – Distributed Ledger Technology: Blockchain – In the strictest sense, distributed ledger technology (DLT) is a type of database that is consensually shared and synchronized across nodes in a network of multiple sites, geographies or institutions.[1090] One specific type of DLT is a blockchain,[1091] which adds blocks of completed transactions to the chain—a series of chronologically and cryptographically linked blocks. While the technology has its origins in cryptocurrency,[1092] it is increasingly regarded as a new general-purpose technology with applications to a wide range of economic activities that rely on consensus of a database of transactions or records. In fact, its rapid development and success in

[1084] ECT Act, s 78 ECT Act; E-Commerce Directive, art 15.
[1085] See 5.3.5 – Safe Harbours.
[1086] B McMahon, 'Imposing an Obligation to Monitor on Information Society Service Providers' (2011) 17(4) CTLR 93.
[1087] Proposal for a Directive of the European Parliament and of the Council on copyright in the Digital Single Market – COM (2016) 593, 29. See also footnote 957.
[1088] S Stalla-Bourdillon and others, 'Open Letter to the European Commission - On the Importance of Preserving the Consistency and Integrity of the EU Acquis Relating to Content Monitoring within the Information Society' (30 September 2016) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2850483> accessed 30 November 2018.
[1089] For instance, Youtube uses its Content ID technology to identify and remove illegally uploaded music and video. Despite the investment of over 60 million USD in the development and implementation of Content ID, users keep finding ways to circumvent the technology.
[1090] Government Office for Science, 'Distributed Ledger Technology: Beyond Block Chain' (2016), 17-18, <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/492972/gs-16-1-distributed-ledger-technology.pdf> accessed 30 November 2018.
[1091] More specifically, a blockchain is a cryptograpically secured distributed ledger. Although blockchain is a specific type of DLT, the terms are often used as synonyms.
[1092] BitCoin in 2009.

relation to cryptocurrency has sparked interest from various organisations, including financial institutions, government agencies and high-tech enterprises.[1093]

Various blockchain-based applications have been proposed for intellectual property management;[1094] however, scholarship in this area is just emerging. The primary application appears to be in rights and royalty processing.[1095] From a 3D printing perspective, blockchain's ability to provide verifiable proof of ownership becomes particularly interesting when trying to differentiate between genuine and unauthorised copies of designs, and in cases where copyright needs to be proven.[1096] While the technology undoubtedly can be used to optimise 'rights book keeping' by keeping a registry of associated meta-data, it remains unclear whether the technology could be used to prevent copyright infringement, particularly in relation to 3D printing.

Creating a blockchain for digital content raises many issues [1097] and blockchain has indeed many shortcomings that are similar to traditional DRM systems. The system would require participation on multiple levels, from the content creators to 3D printer hardware manufacturers. It appears that for digital content, blockchain is limited to encompass transaction data and metadata, not the actual digital content. Thus, digital content can exist outside the blockchain, with less security than the data stored in the chain, making protection in the chain useful. To mitigate this problem, at least for digital music, some propose a system that makes use of a combination of blockchain and digital watermarking.[1098]

A detailed analysis of this technology is outside the scope of this work; however, further scholarship is needed in this area.

[1093] For instance, B Marr, '35 Amazing Real World Examples Of How Blockchain Is Changing Our World' (*Forbes*, 22 January 2018) <https://www.forbes.com/sites/bernardmarr/2018/01/22/35-amazing-real-world-examples-of-how-blockchain-is-changing-our-world/#4708d25c43b5> accessed 30 November 2018.

[1094] See, for instance, M Holland, C Nigischer and J Stjepandi 'Copyright Protection in Additive Manufacturing with Blockchain Approach' in Chun-Hsien Chen and others (eds), *Transdisciplinary Engineering: A Paradigm Shift* (IOS Press 2017) 914.

[1095] For instance, startup 'Binded' uses blockchain technology to create a registry of ownership of creative works. <https://binded.com> accessed 30 November 2018.

[1096] Copyright is obtained without registration and, therefore, a verrifiable source of proof of ownership is imperative in situations where the respective rights are disputed.

[1097] For example, the hash created for a particular work will differs whenever a slight modification is made to the original work, although potentially still covered under the right copyright.

[1098] B Rosenblatt, 'Watermaking Technology and Blockchains in the Music Industry', White Paper (2017) <https://www.digimarc.com/resources/blockchain-watermarking-music> accessed 30 November 2018.

6.2.4 – The Consumer 3D Printing Ecosystem: *Tabula Rasa?*

Thus far, the application of the above-mentioned solutions has proven to be inadequate to combat infringement of digital content.[1099] Digital infringement is impossible to comprehensively monitor and prevent, and enforcement has proven to be inadequate and counterproductive. However, the current consumer 3D printing ecosystem provides a unique opportunity for the development of responses that could mitigate loss of control over copying, modification and distribution of works. Unlike most digitised content, the nature of both digital models and the consumer 3D printing community have prevented design files from becoming increasingly decentralised, for example, through P2P file sharing.[1100] On the contrary, the creation and dissemination of digital models almost exclusively relies on centralised design-specific platforms, and physical distribution largely mimics the 'traditional' market environment. In fact, we have seen that within this centralised element of the ecosystem control of intellectual property is feasible, for instance, through the implementation of DMCA-based notice and takedown systems, and the adoption of different dissemination methods—albeit with potential detrimental effects on digital design creation and availability. However, optimal utilisation of the current consumer ecosystem could lead to mutually beneficial outcomes for both rights holders and consumers. We start the substantiation of this argument by looking at the current system of licensing.

6.3 – Licensing Schemes

A feasible solution towards satisfying the demand for access to digital models could be licensing, as proven by the various schemes that have been applied in other areas of digitisation.[1101] Legal access to the source together with explicit conditions

[1099] LE Edwards and others, 'Framing the Consumer: Copyright Regulation and the Public' (2013) 19(1) Convergence: The International Journal of Research into New Media Technologies 9.
[1100] The process of locating a specific CAD model substantially relies on the design file being accompanied by 2D images of the underlying digital model; a function largely absent from indexes used in the P2P file sharing process. In addition, desing sharing platforms also classify the models into specific categories and provide a platform for collaboration.
[1101] For instance, Google has entered into licensing agreement with a number of rights holders in order to host their content on Youtube. 'Terms of Service' <https://www.youtube.com/t/terms> accessed 30 November 2018; A Macgillivray, 'Youtube's Content Identification Systems and the New Licensing

regarding the permitted uses facilitates both the 3D printing and the design creative process. Creators[1102] reach a global audience, and the rights holders would, subject to the type of licence, receive royalties. At the same time, they maintain the option to utilise other means to control their intellectual property, including legal and technological tools. The integration of licences in effective DRM would significantly ease monitoring and enforcement, and platforms could offer a wide range of designs and increase their revenues.

The following sections discuss the general structure for granting licences on design sharing platforms, irrespective of dissemination method. We then continue to analyse the various licensing models, with particular focus on the licensing scheme currently used within the consumer 3D printing ecosystem.

6.3.1 – General Licensing Structure of Design Sharing Platforms

The structure of licences on design sharing platforms is a complex net of interdependent licenses between user-downloader, user-uploader—generally the right holder—and the platform.[1103] The licensing schemes on platforms differ in accordance with their approaches to design dissemination, openness, and target audience.[1104] Irrespective of these differences, from the perspective of platforms, licences are a *conditio sine qua non* for the platform to legitimately offer its services, including 3D printing, hosting of content, and allowing third parties to upload, download and modify content. The result is that platforms generally require user-uploaders to agree with the terms of a clickwrap licence[1105] or bind them to licences

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Models They Enable' in HC Hansen (Ed), *Intellectual Property Law and Policy* (Vol 11, Hart 2010), 230.

[1102] Including designers and inventors.

[1103] K He, 'Regulating Terms and Conditions of Copyright Licences of the User-Generated Content 3D Printing Platform' in Rosa Maria Ballardini, Marcus Norrgård and Jouni Partanen (eds), *3D Printing, Intellectual Property and Innovation – Insights from Law and Technology* (Wolters Kluwer 2016) 245-250.

[1104] This section primarily focusses on digital dissemination platforms, such as Thingiverse. However, the analysis applies mutatis mutandis to cloud and physical distribution models.

[1105] 'A type of legal agreement used for software programs or online services, for which a user indicates acceptance by selecting a button or link before he or she is given access.' 'clickwrap, n' (*OED Online*, OUP December 2018) <https://www.oed.com/view/Entry/37480879> accessed 30 November 2018.

in their terms and conditions.[1106] For example, by uploading content to Thingiverse, the user grants the platform

> an irrevocable, nonexclusive, royalty free, sub-licensable, fully-paid, and worldwide license to reproduce, distribute, publicly display, and perform, prepare derivative works of, incorporate into other works […] and to grant sublicenses of the foregoing […].[1107]

This 'licence-in', from the perspective of the platform, allows it to, amongst other things, reproduce the design and sublicense user-downloaders to reproduce and prepare derivative works of the content. Apart from these economic rights, users are generally required to waive their moral rights. In turn, the platform grants the user-uploader a licence, 'licence-out', to use the content and software on the platform. User-uploaders have almost no influence on these terms and conditions, and the scope of the licence concerning the use of the platform;[1108] however, they can usually determine the scope of the vertical licence between the user-uploader and user-downloader. The conditions of this licence ultimately determine the extent to which the end-user, *i.e.* the user-downloader, is able to customise, modify and produce the underlying design.

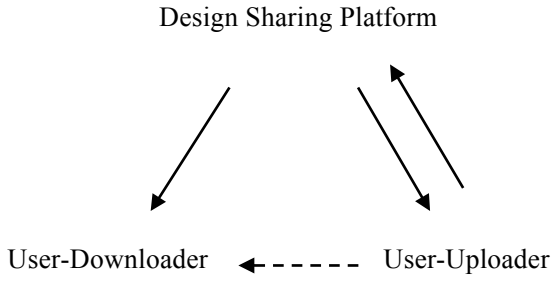

Figure 7 – Structure of Licences on Design Sharing Platforms

The licences granted by user-uploaders to the platforms are drawn by the platforms with no input from these users, and they arguably unduly deprive rights holders of

[1106] J Miles, 'Distributing User-generated Content: Risks and Rewards' (2007) 18(1) Ent L R 28, 30. All platforms publish their terms and conditions on their website.
[1107] Makerbot, 'Makerbot Terms of Use' (17 October 2017), clause 3.2 <https://www.makerbot.com/legal/terms> accessed 30 November 2018.
[1108] Protest actions against Thingiverse's changed terms and conditions has had little to no effect. He (n 1103) 248-249.

their rights.[1109] For instance, in the case of Thingiverse, the grant of irrevocable rights may bar user-uploaders to licence their works to others outside the platform's context. Similarly, the waiver or their moral rights would prevent the authors from taking legal actions against distortions of their work. However, companies offering designs through the current platforms appear to get individualised licensing agreements.[1110]

6.3.2 – Open Source Licensing Schemes

Open source licensing is often equated to free-of-charge.[1111] While this is often true,[1112] the primary feature of open source licences is that they broadly allow the access to the source of the work, which can subsequently be used, modified and shared under the conditions spelt out in the licence. Open source has its origins in the context of software and is therefore linked to access to, and modification of, the source code; however, open source can be applied to others 'sources' of a work, including blueprints and digital models in the context of 3D printing. The extent to which people can use, study, modify and distribute the works in this context is determined by the open source licence.

This type of licensing has become a particular feature of the digital environment, which is often characterised by user-created and freely disseminated content.[1113] Similarly, open source licensing plays a key role in the context of digital designs for 3D printing. The 3D printing community is based on the principle of openness, and many 3D printing hardware, software and designs are thus open source.[1114] The most commonly-used open source licences are available online and free-of-charge. This directly contributes to wider dissemination of content.[1115] The permissions to use and adapt through open source licensing allow designs to be

[1109] He (n 1103) 249-250.
[1110] For instance, the licensing of the South Park product line by Viacom/Comedy Central to Shapeways. <https://www.shapeways.com/shops/south-park> accessed 30 November 2018.
[1111] Free in the context of open source licensing usually means that users are free to use, modify and continue to share the software.
[1112] Free of charge does not necessarily implicate an open source character.
[1113] J Cahir, 'The Withering Away of Property: The Rise of the Internet Information Commons' (2004) 24(4) OJLS 619–41.
[1114] 1.2.1 – The 3D Printing Market Dichotomy
[1115] By attaching the license to the work in advance, users do not need to seek permission for the stipulated uses.

developed and adapted to meet evolving or local needs.[1116] While the for-profit utility of open licences continues to be questioned, various business models now exist that employ open licences for financial profit.[1117]

Even though 3D printing-specific open source licences have been proposed,[1118] the most widely-used licences in the context of digital models are offered by Creative Commons. While these licences can also be applied to software, including CAD software, the most important licences in regard to free and open source software (FOSS) are those provided by GNU.[1119] This type of licence fulfils a key role in the licencing of 3D printer hardware designs. [1120]

6.3.2.1 – Creative Commons – Creative Commons (CC) is a non-profit organisation that aims to promote access to copyright materials by providing easy-to-use, standardised copyright licences and other tools for free public use.[1121] In the present context, the Creative Commons Public License (CCPL) scheme is key. It provides for six different licences between which the user can choose.[1122] While a core set of rights—including the rights to reproduce, redistribute, communicate to the public, make available to the public and perform the work—is always permitted through a worldwide, royalty-free, non-exclusively and perpetual licence, the licensor can choose from six licences that consist of a combination of the following conditions:[1123]

- BY – Attribution: The users of the work must provide attribution to the licensor. This condition is mandatory for all licences.

[1116] Rideout (n 61).
[1117] H Hietanen, V Oksanen and M Välimäki, *Community Created Content: Law, Business and Policy* 78 – 101. See also P Stacey and S Hinchliff Pearson, *Made with Creative Commons* (2017 Ctrl+Alt+Delete Books).
[1118] E Greenbaum, 'Three-dimensional printing and open source hardware' (2013) 2 NYU J Intell Prop & Ent L 257.
[1119] A Guadamuz, 'Free and Open-Source Software' in L Edwards and C Waelde, *Law and the Internet* (3rd edn, Hart 2009) 373.
[1120] The majority of 3D printer designs have been made released under a GPL licence. <https://reprap.org/wiki/RepRap_Options>, accessed 30 November 2018.
[1121] CC tools that are not licences are CC0, a type of license under which the licensors waive all their rights worldwide, and the Public Domain Mark, a tool that identifies works free of copyright.
[1122] <https://creativecommons.org/licenses> accessed 30 November 2018.
[1123] <https://creativecommons.org/licenses/by/4.0> accessed 30 November 2018. See also T Simmonds, 'Common knowledge? The rise of Creative Commons licensing' (2010) 10(3) LIM 162.

- SA – Share Alike: The creation of derivative works is permitted but subject to the licensing of the resulting work under the same or an equivalent licence.
- NC – Non-Commercial: The work may be used solely for non-commercial purposes.
- ND – No Derivatives: The licensor reserves the right to make derivative works.

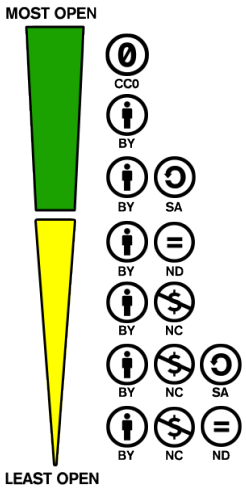

Figure 8 – Creative Commons Licenses Level of Openness

All CC licences define 'licensed work' as 'the artistic or literary work, database, or other material to which the Licensor applied this Public License'.[1124] These licences deal with copyright and related rights, but do not license moral rights;[1125] however, moral right are waived subject to the rights licensed.[1126] The CCPL explicitly excludes trade mark and patent rights from its scope,[1127] and design rights are also not covered by the licence. The result is that the CCPL can govern, in the context of 3D printing, copyright in CAD models and physical objects works of applied art and design, but not the design rights thereof. This may cause the paradoxical situation

[1124] For instance, Creative Commons Attribution 4.0 International Public License, s 1(f). <https://creativecommons.org/licenses/by/4.0/legalcode> accessed 30 November 2018. This definition is significantly simplified compared to the definition in the Creative Commons 3.0 International Public Licence.
[1125] Creative Commons Attribution 4.0 International Public License, s 2(b)(1). <https://creativecommons.org/licenses/by/4.0/legalcode> accessed 30 November 2018.
[1126] ibid.
[1127] Creative Commons Attribution 4.0 International Public License, s 2(b)(2). <https://creativecommons.org/licenses/by/4.0/legalcode> accessed 30 November 2018.

where a user is allowed to perform certain acts under the copyright regime, while the designs regime—excluded from the CC licence—prohibits very similar activities.[1128]

6.3.2.2 – GNU – In 1983, Richard Stallmann launched GNU[1129] as an operating system to provide a Unix-compatible system that would be completely free.[1130] To this end, published software would need to be released under a free software licence, which led to the GNU licensing scheme.[1131] Software is generally licensed under the GNU General Public License (GNU GPL).[1132] This type of licence is based on access to the source code,[1133] and provides the users permission to use and modify the software in any way they seem fit, albeit within the stated conditions.[1134] The licence also restricts the use of the licensed software to create commercial software. Related documentation and text on how to use the software is normally licensed under the GNU Free Documentation Licence (GNU FDL).[1135] Accordingly, GNU licences can be used to licence 3D printer hardware.

6.3.3 – Voluntary Collective Licence Schemes

At least for music file-sharing, various versions of 'voluntary collective licences' have been proposed to mitigate the loss of revenue of rights holders in the digital

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[1128] T Margoni, 'CCPlusDesign.EU – Or How to Apply Creative Commons Licences to 3D Printed Products in the Light of the Most Recent Developments of the European Court of Justice' (27 May 2015) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2611152> accessed 30 November 2018.
[1129] GNU is a recursive acronym that means 'GNU is Not UNIX.'
[1130] R Stallmann, 'The GNU Operating System and the Free Software Movement' in C Di Bona, S Ockman and M Stone (eds), *Open Sources: Voices from the Open Source Revolution* (O'Reilly & Associates 1999). An operating system is a computer programme that allows computers to function. It is the basic interface between the use and the computer. Examples are Microsoft Windows, OSX, Linux and UNIX.
[1131] The Free Software Foundation was formed to accomodate the GNU project.
[1132] The full text of version 3 of the licence can be found at <https://www.gnu.org/licenses/gpl-3.0.txt>, accessed 30 November 2018. The first version dates from 1989 and was known as the EMACS General Public Licence. The second version was released in 1991. G Moody, *Rebel Code: Linux and the Open Source Revolution* (Penguin 2002) 26–29.
[1133] GNU GPL v3, preamble <https://www.gnu.org/licenses/gpl-3.0.txt> accessed 30 November 2018.
[1134] ibid. There are two variations of the GNU GPL: The GNU LGPL is specifically designed for the use of libraries in proprietary programs, while the GNU AGPL provides an additional provision to the GNU GDP to allow users who interact with the licensed software over a network to receive the source file of the work. <https://www.gnu.org/licenses/licenses.html> accessed 30 November 2018. These variations are, however, not relevant in relation to 3D printing.
[1135] In some instances other free documentation licences are used.

environment.[1136] Rights holders would form or use a collecting society, which, in turn provides blanket licenses to everyone, subject to a fee. The collecting society would distribute the collected fees amongst its members, thus assuring remuneration of the rights holders. The implementation of the system does not involve any changes to the current law; however, the efficacy of this system relies on the participation of all rights holders, users and intermediaries. For this reason, a voluntary licensing system is highly unlikely in the context of music file-sharing, let alone in the context of design file sharing. In any case, the issue of 'free-loaders' remains, and unwillingness to pay the fee would significantly undermine the system.

6.3.4 – Beyond the Dissemination Dichotomy

Two distinct approaches define the current design dissemination environment. Rights holders who seek remuneration and oversight over the quality of the end-product opt for the restrictive physical dissemination model, while creators within the consumer 3D printing community rely on digital dissemination. The reason for this dissemination dichotomy is that both rights holders and users strive for control over the source file; rights holders to protect their economic and reputational interests, and users to enable private 3D printing, customise, modify, and follow-on create. The contention is that these interests ultimately conflict. This section has shown that the implementation of an effective licensing scheme could safeguard the economic interests of the right holder; however, voluntary collective licensing is difficult to achieve as it would require all rights holders to join. And while open source licensing could provide for an individual remuneration scheme, it appears that reputational interests can only be protected through physical dissemination that ensures quality over the end-product.

But considering the broad scope of consumer 3D printing, generalising seems to be inappropriate and, therefore, the following section surveys various interdependent actor and situation-specific responses. This approach is further supported by the current dynamics within the consumer 3D printing ecosystem,

[1136] F von Lohmann, 'A Better Way Forward: Voluntary Collective Licensing of Music File-Sharing', version 2.1 (30 April 2008) <https://www.eff.org/files/eff-a-better-way-forward.pdf> accessed 30 November 2018.

including the risk of intellectual property infringement,[1137] the capabilities of consumer-grade 3D printing hardware,[1138] and the functioning of design sharing platforms.[1139]

6.4 – New Business Models

> The first line of defence against pirates is a sensible business model that combines pricing, easiness of use, and legal prohibition in a way that minimize the incentives for consumers to deal with pirates.[1140]

Increased competition and the potential impact of consumer 3D printing on their revenue will likely influence rights holders' approaches to implementing new business models and the decision to make their products available for 3D printing. Ultimately, most rights holders want to safeguard their economic interests and prevent, or at least minimise, intellectual property infringement of their assets. New business models evolve around two interrelated questions: (i) Do rights holders make their products available for 3D printing, and how?; and (ii) how will they approach the potential of co-creation and peer-production?

6.4.1 – Approaches Towards Design Dissemination

6.4.1.1 – Not Making Products Available – Rights holders could choose not to integrate 3D printing in the offering of their products, accessories, or replacement parts. Technical premises primarily determine the applicability and adequacy of 3D printing to products, including materials, complexity, dimensions, and most importantly economic efficiency, including production cost. A second consideration is consumer demand for a particular (3D printed) product—be it through 3D printing services or personal manufacturing. In any case, the incorporation of 3D printing in

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[1137] 1.2.3 – The Status of Consumer 3D Printing .
[1138] 1.3.3 – Printing: Typology of 3D Printing Technologies.
[1139] 1.5 – Design Dissemination Methods.
[1140] J Lacy, J Snyder and D Maher, 'Music on the Internet and the Intellectual Property Protection Problem', Proceedings of the International Symposium on Industrial Electronics (IEEE Computer Society Press 1997), 79 <http://ieeexplore.ieee.org/document/651739/> accessed 30 November 2018.

the manufacturing and making available of products demands that rights holders consider the various dissemination options: physical dissemination, streaming and digital dissemination. The choice of design dissemination will determine the level to which they can control the integrity of the digital model and quality of standard of the end-product, and thus the potential detrimental effects on the reputation of their brand. Nonetheless, as we have seen in the music industry, the refusal to adapt to digitisation could lead to losing control over the distribution and thus potential revenues.[1141]

6.4.1.2 – Control Over the Source File without Enabling Decentralised Manufacturing – The licensing of famous designs for 3D printing via physical dissemination platforms has been welcomed as setting an example in the industry for other brands determining the best way to react to 3D printing and the disruption it brings. [1142] The physical distribution method is regarded to benefit both the rights holder and the consumers.[1143] It secures the interest of rights holders, and allows them the allocation of revenue and ability to exercise control over the quality of the end-product. Consumers, on the other hand, could gain access to niche products for which the demand is too low to justify mass production. This is particularly the case for goods that cannot be manufactured using consumer-grade 3D printing hardware.

This method safeguards the rights of the respective rights holders through centralised manufacturing and physical distribution, however, it rejects two key elements of consumer 3D printing: consumer creativity and decentralised manufacturing. It considers 3D printing as an alternative manufacturing method for the production of small units, rather than a 'home factory'.

[1141] See, for instance, Owsinski (n 24).
[1142] The South Park product line has been licensed by Source3 from Viacom/Comedy Central. <https://www.shapeways.com/shops/south-park> accessed 30 November 2018. See also Hasbro, '3D Systems and Hasbro Agree to Co-venture and Mainstream 3D Printing Play Experiences for Children' (Press Release, 14 February 2014) <https://www.3dsystems.com/press-releases/3d-systems-and-hasbro-agree-co-venture-and-mainstream-3d-printing-play-experiences> accessed 30 November 2018.
[1143] See, S Dama and A Chinmaye 'Printing a revolution: The Challenges of 3D Printing on Copyright' (2016) 84 Geo Wash L Rev Arguendo 68, 80.

6.4.1.3 – Control Over the Source File with Enabling Decentralised Manufacturing – Theoretically, cloud 3D printing, or streaming, could equally consider the interests of the consumer and right holder; it allows for both customisation and decentralised manufacturing of designs but restricts unauthorised access to the source file. The source files cannot be directly accessed, copied or altered by the consumer, which significantly reduces the risk of unauthorised dissemination of the design file.[1144] By effectively protecting the rights in the design, this way of distribution could promote the making available of designs for 3D printing. However, streaming is widely unpopular within the current 3D printing community.[1145] The lack of access to the source file significantly limits the ability to customise, and interoperability issues prevent mass adoption. In spite of these shortcoming, increased control over the source file could encourage rights holders to make their products available for home 3D printing. Many (future) 3D printing consumers are not CAD literate and do not require adaptations to the digital model; and it appears mass adoption of this dissemination model hinges on the seamless integration of digital models, print files, hardware and DRM. However, in absence of such integration, the current consumer 3D printing environment requires access to the source file to allow adaptation of the design model and print file to produce objects without flaws.

6.4.1.4 – No Control Over the Source File – Making the source file available amounts to loss of control. Once users have access to the CAD model, rights holders cannot practically prevent further distribution and customisation, and downstream integrity of the file cannot be guaranteed.[1146] By implication, the making available of CAD marks a significant loss of control over the end-product, the 3D printed object, and the transfer of manufacturing capabilities to the consumer implies a loss of

[1144] DR Desai and GN Magliocca 'Patents, meet Napster: 3D Printing and the Digitization of Things' (2014) 102 Geo L J 1691,1714; D Mendis, "'The Clone Wars": Episode II – The Next Generation: The Copyright Implications Relating to 3D Printing and Computer-Aided Design (CAD) Files' (2014) 6(2) Law, Innovation and Technology 265, 280.

[1145] The dissemination model has been rejected by the 3D printing community. 'The New Cloud-based Streaming Has Arrived' (*Pinshape,* 11 May 2015) <https://pinshape.com/blog/the-3d-printing-cloud-based-streaming-has-arrived/> accessed 30 November 2018; 'Feature Update: Removing Streaming to Make Designs More Accessible' (*Pinshape*, 17 May 2016) <https://pinshape.com/blog/pinshape-removing-streaming> accessed 30 November 2018.

[1146] Despite the potential application of DRM and other technological protection tools. 6.2 – Controlling Intellectual Property Rights.

control over essential characteristics of the product, such as colour, material use and quality—all of which are dependent on the hardware and skills applied used during the 3D printing process. However, this method overcomes the access barrier to design files for consumers who are not CAD software literate or otherwise unable to create their own digital models. Most importantly, by making the CAD model available this dissemination method allows consumers that have the required knowledge and skills to adapt and customise the design for personal 3D printing.

The legal availability of the source files raises the key question as to how to persuade consumers to use the legal rather than illegal files. The same question has arisen for digital music and films, where in spite of the availability of numerous legitimate download platforms, illegal file sharing remains a serious issue.[1147] Several factors can minimise the incentives for consumers to resort to pirating digital files, including pricing, quality, unrestrictive digital rights management and ease of use of the design sharing platform.[1148] Design models must thus be available at a competitive price and assure a qualitative physical 3D printed object. The contention is that when providing affordable access to legal designs of high quality, there is no valid reason to access and download unauthorised content.

6.4.2 – Approaches Towards Co-creation and Peer-production

Established industries have in the past responded to disruptive technologies by changing business models and, at least to some extent, embracing new user behaviour. Users are increasingly involved in the creative and innovation process, and it is critical to consider responses towards co-creation and peer production. In essence, increased consumer engagement and good business practises are considered to a be the preferred way forward.[1149]

In analysing rights holders' approaches towards consumer creativity, Berthon

[1147] HR Varian, 'Copying and Copyright' (2005) 19(2) JEP 121.
[1148] O'Flynn (n 1005) 219–21.
[1149] JC Storch, 3-D Printing Your Way Down the Garden Path: 3-D Printers, the Copyrightization of Patents, and a Method for Manufacturers to Avoid the Entertainment Industry's Fate' (2014) 3 NYU J Intell Prop & Ent L 249.

and others differentiate between two axes: attitude and action.[1150] The attitude of the rights holders that are aware of the phenomenon of creative consumers[1151] can be either positive or negative, while their actions can be either active or passive. Various non-legal considerations also play a role in determining their stance, including the resources available, branding and other strategic considerations.

Rights holders attitude towards creative consumers

Rights holders actions towards creative consumers	**Negative**	**Positive**
Active	**Resist:** Actively restrain consumer creativity	**Enable:** Actively facilitate consumer creativity
Passive	**Discourage**: But *de facto* tolerate/ignore consumer creativity	**Encourage**: But don't actively facilitate consumer creativity

Figure 9 – Rights Holders Stances Towards Creative Consumers[1152]

The rights holders' stance towards consumer creativity and innovation needs to be distinguished from their approach towards design dissemination; however, the type of design dissemination method chosen by a rights holder, *i.e.* whether or not provide access to the source file, influences the extent of user creativity.

[1150] PR Berthon and others, 'When Customers Get Clever: Managerial Approaches to Dealing with Creative Consumers' (2007) 50 Business Horizons 39, 44-45. For the purpose of this work, the term 'firm' as used by Berthon has been replaced by 'rights holders'.
[1151] Berthon and others identified awareness as a third precursor dimension. ibid. 45. See also RM Ballardini, J Lindman and I Flores Ituarte, 'Co-creation, Commercialization and Intellectual Property – Challenges with 3D Printing' (2016) 7(3) EJLT 1, 11.
[1152] Berthon (n 1150) 44.

Customisation and follow-on creation hinges on access to the source file,[1153] which is only available under the digital dissemination model. This said, it is likely that users will eventually get access to source files and creativity *will* happen,[1154] yet a rights holder's stance can influence *how* and *to what extent*.

Much of this user-based creativity incorporates existing material in a derivative of transformative form, and typically amounts to infringement.[1155]

6.4.2.1 – Discourage – A passive attitude is often the initial stance adopted by many rights holders. The combination of passive actions with a negative attitude towards consumer creativity is qualified by Berthon as 'discouraging'. This stance can be attributed to various factors such as ignorance or tolerance. A discouraging stance avoids bad publicity that often accompanies negative actions. While under this stance rights holders' attitude towards consumer innovation is negative, their actions are passive and consumer creativity is not facing active resistance, thus maintaining the *status quo*.

6.4.2.2 – Resist – Rights holders might actively try to minimise or eliminate consumer creativity: the 'resist' stance. The reasons for this typically include the fear of negative consequences for the rights holder, such as revenue loss and reputational damage. Similar to 'discouraging' the attitude towards consumer creativity is negative; however, it is accompanied by active resistance rather than a passive attitude, including the application of restrictive TPMs, aggressive take-down notices, cease and desist letters, and legal action. These negative actions are detrimental to consumer creativity, and could prove to be ineffective and counterproductive.[1156]

6.4.2.3 – Encourage – The 'encourage' stance holds that rights holders adopt a primarily positive attitude toward consumer creativity, combined with passive (in)actions. Similar to the discouraging approach, this passive, hands-off approach

[1153] With the exception of minor customisation option in the cloud for both cloud printing and physical dissemination.
[1154] CAD literate consumer can create their own CAD models based on
[1155] 5.3 – Digitisation, Decentralisation and Copyright Infringement.
[1156] Earlier in this work it was established that the application of technological tools and increased legal action is inadequate to combat infringement of digital content, including CAD models. See 6.2.2 – Legal Enforcement; 6.2.3 – Technological Protection Tools.

does neither hamper nor directly facilitate consumer creativity, and from a consumer perspective it is the preferred approach above the resistance stance which effectively tries to limit creativity. However, the passive stance may leave revenue-generating opportunities untapped for rights holders and, therefore, they might want to consider 'enabling' consumer creativity.

6.4.2.4 – Enabling – The most positive stance towards the consumer creativity phenomenon from a rights holders' perspective is 'enabling'. In addition to adopting a positive attitude towards consumer creativity, this approach actively facilitates such creativity. One way to actively promote consumer creativity is to make designs available through digital dissemination, thereby providing access to the source file necessary for follow-on creation. In addition, rights holders can actively enable consumer innovation through the sale of products that are complementary to user-developed innovations and providing of interchangeable and customisable designs, and through co-creation, including the production of user-developed innovations for general sale and collaborations with user-designers.[1157] For example, in 2014 Shapeways entered into a licensing agreement with Hasbro, under which Shapeways is allowed to sell 3D printed items that embody Hasbro's intellectual property, but are created by third parties.[1158] In return Hasbro is entitled to a share of the profits made from the sale of the UGC.[1159] These new relationships between users and producers could be mutually beneficial. In this instance, rights holders actively facilitate consumer creativity by promoting creation based on their intellectual property and, in return, receive a part of the profits. In a similar manner this licensing system could be implemented within the digital dissemination method: instead of filing take down notices to users and design sharing platforms, rights holders could enter into a situation-specific licensing agreement with platforms. This license could allow the platforms to host the files and the consumer to customise and materialise the digital

[1157] von Hippel, *Democratising Innovation* (n 169) 14–15.
[1158] It should be noted that at first only five artists will be allowed to create and sell this artwork. However, over time Hasbro hopes to expand the partnership to include more artists. EA Harris, 'Hasbro to Collaborate With 3-D Printing Company to Sell Artwork' *The New York Times* (20 July 2014) <https://www.30 November 2018. In addition, the designs will first need to be cleared by Hasbro. The price, however, is set by the creator. TJ McCue, 'Hasbro Offers Artwork For 3D Printing at Shapeways' (*Forbes*, 31 July 2014) <https://www.forbes.com/sites/tjmccue/2014/07/31/hasbro-offers-artwork-for-3d-printing-at-shapeways/#199624841f6c> accessed 30 November 2018.
[1159] ibid.

model subject to the respective licence. The rights holder receives remuneration with the risks of increased digital dissemination of the respective design file.

6.5 – Conclusion

Digitisation and 3D printing significantly undermine rights holders' ability to control the creation, adaptation, dissemination and production of their intellectual property goods. In the past, industries that heavily relied on intellectual property have consistently lobbied to safeguard their interests, and informational goods and services created as result of digitation have been increasingly commoditised by law and technological means.[1160] However, significant investment is required for the effective protection, monitoring, and enforcements of rights in the digital environment, and this chapter submits that strict control through legal actions and technological tools will not accomplish the expected results in the consumer 3D printing context. The real problem, however, is that rights holders are caught in the somewhat paradoxical situation where their reluctance to adapt to 3D printing out of fear for increased infringement may, in the end, lead to more infringement. Their inaction to make products available for 3D printing could be an impetus for the creation and dissemination of unauthorised models. These outcomes are situation-based and rights holders should adapt when circumstances change.

[1160] KJ Koelman, 'The Public Domain Commodified: Technological Measures and Productive Information Use' in L Guibault and PB Hugenholtz (eds), *The Future of the Public Domain: Identifying the Commons in Information Law* (Kluwer 2006) 105-119. Technological means are themselves protected by anti-circumvention laws. See below 6.2.3.2 – Anti-circumvention.

Chapter Seven
Conclusion and Recommendations

'3D printing should be lightly regulated, because it enables precisely the kind of creation and progress of the useful arts and sciences that intellectual property is supposed to foster.'[1161]

7.1 – Conclusion

This final chapter seeks to formulate an answer to this thesis' research question and its sub-questions, based on what was discussed in the previous chapters: how can the intellectual property framework be used and optimised to promote consumer 3D printing? Some emphasis is on the related question whether it is possible to fairly balance the interests of the key actors within the consumer 3D printing ecosystem. This chapter highlights the key contributions and findings of this work and concludes by suggesting that, in as far as the intellectual property is concerned, a balance can be struck between the various interrelated, overlapping, and conflicting interests. It provides for a number of general and situation- and actor-specific recommendations to achieve such balance.

7.1.1 – Grounded in Technological and Social Premises

The legal analysis in this work addresses only one dimension of the larger debate over 3D printing and intellectual property rights. Its focus on the consumer 3D printing segment led to an inquiry that considered the key dynamics within the consumer 3D printing ecosystem, including technology (*i.e.* the production process and dissemination models) and social dynamics (*i.e.* the relationship between the various actors and, especially, collaborative elements). This was done with a view of adopting a holistic and pragmatic approach towards contextualising consumer 3D printing within the various intellectual property regimes.

[1161] Desai and Magliocca (n 1144) 1719–20.

Chapter One described a consumer ecosystem that promotes creativity and innovation which can effortlessly be materialised through 3D printing—the effort and cost of distribution is virtually zero. It is characterised by a dynamic landscape of actors, in interrelated, conflicting and potentially overlapping capacities. And within this ecosystem, as correctly observed by one commentator, 'the role of intellectual property […] is both controverted and critically important.'[1162] Creativity within the consumer 3D printing community is flourishing despite the absence of effective intellectual property enforcement, and is largely based on collaborative innovation and open appropriability regimes. This system of creativity relies on access to the source file, authorised or unauthorised, and requires the facilitation of file sharing, co-creation and peer production by online platforms. An orthodox view of intellectual property would suggest that the availability of digital models poses a risk for individuals and companies that rely heavily on intellectual property due to the risk of their products being illegally digitised, copied, disseminated and produced in a decentralised manner. However, the technological premises indicate that the intellectual property challenges are currently limited to specific industries, sectors and goods. Various limitations, including size, accuracy and material use, significantly narrow down the type of objects that can be manufactured using consumer 3D printers, and the impact on the intellectual property system is rather small. However, this may change going forward as capabilities of consumer 3D printing improve and the technology is adopted more widely.

The technological premises, including the technology available to consumers, the design dissemination methods, and the consumers' knowledge thereof also determine to what extent 3D printing affects the rationale (see 7.1.2) and scope (see 7.1.3) of the various intellectual property regimes examined.

7.1.2 – Challenges and Gaps within the Current Intellectual Property Systems

3D printing affects various aspects of the different forms of intellectual property, including the rationale for intellectual property protection as well as its applicability and enforcement. Chapter Two described how the combination of digitisation and decentralised manufacturing challenges the consumer-protection rationale of trade

[1162] Lemley (n 15) 462.

marks. Decentralised manufacturing through personal 3D printing further diminishes the trade mark owner's ability to exercise control over the end-product, *i.e.* the 3D printed object and challenges the reasonable belief that trade mark owners, to some extent, control over the quality of their products. As consumer expectations of trade marks change, trade marks are less and less able to fulfil their traditional functions as indicators of source and quality. This thesis submits that the extent to which consumer 3D printing affects the rationale for trade mark protection depends on three dynamic and interrelated factors: (i) the attributes of consumers regarding 3D printing, including their understanding of 3D printing and its capabilities, (ii) the type of technology available for consumer use, and (iii) the dissemination model.

In addition to the challenges posed to the rationale of trade marks, this work identified a number of challenges and gaps that indicate that the current intellectual property framework is not sufficiently geared towards dealing with consumer 3D printing. The main gap concerns enforcement theory and practice, and the problems caused by the combination of digitisation and decentralised manufacturing in this context. Within an increasingly decentralised consumer 3D printing ecosystem, two central applicability issues become ever-more prominent: (i) the private and non-commercial nature of individual infringement, and (ii) the equation of physical objects to their digital embodiment.

The non-commercial and private nature of most consumer 3D printing significantly limits the application of various intellectual property regimes. Often, they hold explicit requirements of application in a commercial setting, for example the 'in the course of trade' within trade mark law, and exceptions and limitations for non-commercial and private purposes found within copyright, patent and designs law. The result of these conditions is that there is no infringement or an exclusion from liability, when protected objects are materialised for non-commercial and private purposes.[1163] This brings to the fore the role and liability of intermediaries that host and disseminate digital models, and thus the need for legal means to enforce intellectual property rights within the digital environment. This need is further stressed by the practical issues that characterise individual enforcement, such as the detection and location of infringement.

[1163] Includes objects to which trade marks have been applied.

However, there remains great uncertainty regarding the application of the various intellectual property regimes in the digital environment, particularly in relation to CAD models. Within trade mark, patent and designs law, the theories of indirect infringement do not exist, or are unclear or inadequate to sufficiently enable rights holders to enforce their rights.[1164] A key question is whether CAD models can be equated to their physical equivalents. Traditional scholarship holds that digital versions of an object are mere precursors of the physical objects and, consequently, the making, using, selling, offering to sell and importation cannot lead to direct infringement.[1165] This stance is especially problematic in the 3D printing environment where decentralisation of manufacturing makes direct infringement difficult to detect, and the law lacks remedies against the dissemination of digital versions of the protected subject matter.[1166]

The question whether CAD models can be equated to their physical counterpart is particularly relevant in the area of copyright law. While there remains uncertainty as to their qualification, CAD models are copyright subject matter. On the one hand, equating CAD models to the underlying good means that these models themselves must qualify as copyright subject matter as if they would have been physically made. The result, as far as South African law is concerned, is that only CAD models of artistic works would be eligible for copyright protection, in particular as sculptures or works of craftsmanship. CAD models of works outside of these qualifications would consequently be denied copyright protection. It should be noted, however, that while South Africa applies a closed list approach towards protectable subject matter, the listed sub-categories are non-exhaustive, and other works that qualify within one of the primary categories may be eligible for copyright protection. In the light of European case law it can be argued that in the UK anything that is the result of intellectual creation could obtain copyright protection, regardless of the closed list of subject matter.[1167] Considering that the creative elements are held in the

[1164] For instance, the theory of indirect infringement is absent from designs law and under patent law it remains unclear as to whether the dissemination of a CAD model amounts to indirect infringement. Regarding legal uncertainties, see 7.1.3 – Legal Certainty.
[1165] 3.4.1 – Equating CAD models to Physical Goods; 4.2.1 – Equating CAD Models to Physical Objects.
[1166] See, however, the legal uncertainty regarding indirect infringement by providing CAD models in the context of patent law. 7.1.3 – Legal Certainty.
[1167] See fn 700.

digital model itself, rather than externally, this analysis boils down an appreciation of the standard of originality in the underlying item.

On the other hand, qualifying CAD models as drawings, irrespective of the purpose or nature of the underlying object, indirectly extends copyright protection to objects embodied in the model, including objects that would otherwise not qualify for protection, and the copyright in the CAD model would prevent the reproduction of the model, both digitally and physically. This result calls for limitations to restrict the application of copyright to protect the manufacturing of non-copyright objects. The broad originality standard under South African copyright law appears to allow copyright protection for drawings where there is 'mere labour' or 'mere skill', including simple drawings of functional items. Because of the more stringent EU standard of originality, the bar under UK copyright law is significantly higher and arguably excludes cases where technical considerations limit the creative freedom of the author.

Apart from these identified gaps, it must be noted that the cross-dimensional scope of 3D printing creates a complex dynamic of rights in which the copyright protection of CAD models that conflicts with the protection of their physical embodiment provided under other intellectual property regimes, particularly the law of patents, designs and trade marks.[1168]

7.1.3 – Legal Certainty

In addition to the shortcomings within the current intellectual property framework as already mentioned, the analysis in this thesis has shown an urgent need for improved legal certainty as far as the requirements for protection and infringement under the current intellectual property framework are concerned. Legal certainty helps in avoiding legal disputes and promotes consumer use, creativity and innovation, and legal uncertainty could result in overclaims of rights in digital models, aggravate chilling effects, and lead to unpredictable and inconsistent outcomes in both litigious and non-litigious dispute resolution.

[1168] See Chapters Two, Three and Four.

A central issue concerning legal uncertainty is defining the 'consumer' within the 3D printing environment. The attributes of consumers in the context of 3D printing are imperative to determine the scope of protection of both trade marks and designs. Within trade mark law there is uncertainty regarding consumers' expectations and perceptions of marks applied to 3D printed goods, and as suggested above, their interpretation depends on three related subjective and technology-dictated factors.[1169] The definition of 'consumers' and their perceptions determine confusion-based infringement, in particular the requirements of 'use as a trade mark'[1170] and 'likelihood of confusion'.[1171] Consumer 3D printing raises similar issues concerning consumers' attributes within designs law.[1172] Both the test for registration and infringement of a design involve an identical concept, and the interpretation of key conditions within each of these two factors is established by a user-based test. This test underpins the design rights system and is likely to give rise to subjective appraisals within the 3D printing ecosystem. Defining consumers and their attributes in the consumer 3D printing realm is ultimately up to the courts.

Apart from delineating the concept of 'consumer' within trade mark and designs law, various concepts within the different intellectual property regimes require clarification. Within the law of trade marks two concepts create a precarious environment in as far as 3D printing is concerned: (i) use as a trade mark,[1173] and (ii) use in relation to goods.[1174] In particular, it must be clear to what extent CAD models are 'goods' to which the law applies and, subject to the delineation of 'consumer' and their attributes, when there is 'use as a trade mark'.

Designs law plays a central role in 3D printing for the production of spare parts, and therefore requires clarification regarding to the scope of legal repair and prohibited reconstruction.[1175] For instance, in absence of judicial interpretation of the term 'spare parts' the boundaries of the spare-parts exclusion in South African designs law remain unclear.

[1169] 2.2 – The Impact of 3D Printing on the Functions of Trade Marks. See also 7.1.2 – Challenges and Gaps within the Current Intellectual Property Systems.
[1170] 2.3.1 – General Limitations to 3D Printing Trade Mark Infringement.
[1171] 2.3.2 – Confusion-Based Infringement.
[1172] 3.2 – Subjective Appraisals and Democratised Creativity.
[1173] 2.3.1.3 – Use 'as a Trade Mark'.
[1174] 2.3.1.2 – Use 'in Relation to Goods or Services'.
[1175] 3.4.3 – What about Spare Parts?.

The fundamental issue within patent law is whether acts in relation to CAD models could amount to indirect infringement. While there is ongoing discussion on the application of indirect infringement within 3D printing, this work submits that determining indirect infringement is subject to the type and nature of patented object; and will generally include the supply of multiple elements, including object-specific CAD models, 3D printing hardware and materials.[1176]

Copyright has been shaped by digitisation; however, 3D printing links the digital to the physical world and raises some new legal challenges. Intellectual property protection of 3D printable subject matter primarily hinges on copyright protection of the CAD model. The overlap with other intellectual property regimes in the protection of the underlying subject matter provides for the paradoxical situation where intermediaries might enjoy 'safe harbour' protection under copyright system, but still be liable under designs and patent law. Arguments can be made to introduce similar exclusion of liability within other intellectual property regimes; however, the different nature of infringement might make practical application difficult.

7.1.4 – Enabling Consumer Creativity

Consumer 3D printing democratises both the design creative process and manufacturing. Promoting consumer use, and in particular consumer creativity, requires consumer access to 3D printing technology, and equitable access to CAD models. While patent law continues to play a key role in making new 3D printing technologies available to the consumer 3D market,[1177] at the core remains access to CAD models. Many of these models are created through a system of peer production that includes follow-on creation and co-creation. Peer-based creation requires the implementation of flexible exceptions and limitations within copyright law together with balanced digital rights management, including non-restrictive TPMs and the clear communication of rights management information and licensing agreements. This requires considering the scope of the various overlapping intellectual property systems within the 3D printing context in order to avoid conflicting provisions.

[1176] 4.2.2 – CAD Models as Enablers of Infringement.
[1177] 4.3 – Patents and Accessibility to 3D Printing Technology.

Copyright exceptions and limitations play a key role in both enabling use, including processing a file and materialising the underlying object, and enabling follow-on creation and remixing of designs. It is imperative that there is agreement between the exceptions and limitations found in copyright and those within designs law and patent law to avoid negating their intended result. In the absence of conformity, users could find themselves in the situation where acts permitted under one regime could nonetheless be infringing under the other. Crucial to this process is the facilitation of design file sharing which, as concluded above, demands for the expansion of 'safe harbours'.

Balanced and clear DRM systems are crucial to facilitate an unburdened system for both consumer 3D printing use as well as creation and innovation within the legal boundaries. This is because DRM systems provide the necessary means to clearly communicate rights information and the extent to which content can be used, adapted and further disseminated. [1178] In particular, EULAs stipulate the extent to which CAD models can be adapted, and more importantly, be materialised. The absence of such provisions means that consumers could be liable for intellectual property infringement by materialising a CAD model, regardless of whether the this model was legally obtained. Various standardised licensing schemes, such as Creative Commons, are already widely adopted within the consumer 3D printing community; however, similar creativity-enabling licenses are required between rights holders and design sharing platforms to support a mutually beneficial, non-litigious solution for intellectual property infringement.

Restrictive EULAs and TPMs, on the other hand, could stifle creativity and innovation because creators require sufficient access to the source file of protected work together with permissions that allow re-use of the protected objects, for instance to enable follow-on creation. The future application of TPMs to digital designs is, at this point, uncertain; but it is submitted here that caution must be exercised as the investment may prove futile in light of ever-improving circumvention techniques.[1179]

[1178] Bechtold states that 'dynamic' DRM systems, which allow for cumulative and overlapping creativity, should meet two requirements: First, it needs 'rights expression language' in which cumulative creativity can be expressed, and it has to deal with rights holders throughout various generations. See S Bechtold, 'The Present and Future of Digital Rights Management – Musings on Emerging Legal Problems' in Eberhard Becker and others (eds), *Digital rights Management – Technological, Economic, Legal and Policitcal Aspects* (Springer-Verlag 2003) 603–05.

[1179] 6.2.3 – Technological Protection Tools.

7.1.5 – Beyond the Law: Intermediaries and Rights Holders

Balancing the conflicting and overlapping interests of the various actors in the consumer 3D printing environment is not driven solely by legal rules and their enforcement; it is determined by social norms and other dynamics within the 3D printing ecosystem. This research has, therefore, not only investigated the challenges posed to the current intellectual property systems, but also sought to provide guidance how various actors should respond to increased digitisation and decentralisation. In particular, Chapter Six illustrated the limits of control over intellectual property in the 3D printing environment. Technical protection tools require a significant and continuous investment in the protection, monitoring, and enforcements of rights. Ultimately, technical tools and restrictive design dissemination models are only able to mitigate the risk of infringement, rather than prevent it. Legal enforcement against individuals will likely prove ineffective and possibly counterproductive, based on the experiences in other sectors. Increased action against intermediaries, on the other hand, bears the risk of stifling the facilitation of the 3D printing process, and thus indirectly the development of the consumer 3D printing environment. Considering the economic and social norm implications, models of intellectual property management need rethinking; in particular models of enforcement.

The centralised nature of the current consumer 3D printing ecosystem promotes rights management and non-litigious enforcement. Intermediaries enable the sharing and distribution of content, and provide a platform for co-creation and peer production. These intermediaries typically comply with legal requirements posed by the various intellectual property regimes, particularly the notice and take down procedure. Their compliance provides an opportunity for rights holders to manage control of their designs, and further explore business and dissemination models that are built around this centralised model of design dissemination.

7.2 – Recommendations

7.2.1 – Judicial Clarification and Legislative Intervention

> [G]overnments have a role in developing "enabling factors" for creation and use of digital content.[1180]

While the current legislative framework is not directly in conflict with the development of consumer 3D printing and the risks of mass intellectual property infringement are arguably limited at this point, it is submitted here that some legal clarification and minor amendments are needed to promote consumer 3D printing use and creativity while safeguarding intellectual property incentives. The need for judicial clarification exists within the laws of trade marks, designs, patents, and copyright.[1181] It is recommended that courts adequately address these issues in the near future so that, in absence of effective remedies for rights holders, legislative measure can be implemented. In particular, legislative intervention is advised in three areas: (i) consumer use and creativity, (ii) indirect infringement, and (iii) intermediary liabilities.

i. Consumer Use and Creativity

The collaborative nature of digital design creation necessitates the implementation of limitations and exceptions, which while complying with international instruments, facilitate the lawful use of digital models and allow for follow-on creation to promote the 3D printing digital commons. The interrelation between the various intellectual property regimes further demands that exceptions and limitations within the copyright framework are aligned with the scope of protection under the law of designs, patents and copyright.[1182] In as far as copyright is concerned, it is proposed that a more flexible approach is adopted in South Africa to favour both use and follow-on creativity. This approach could consist of the introduction of an open standard, such

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[1180] OECD, 'OECD Policy Guidance for Digital Content', Directorate for Science, Technology and Industry, Committee for Information, Computer and Communications Policy (2008), 3 <https://www.oecd.org/dataoecd/20/54/40895797.pdf> accessed 30 November 2018.
[1181] 7.1.3 – Legal Certainty.
[1182] The application of trade marks is different. Rather than applying to the subject matter itself, trade marks denote a connection between the sign applied to goods and the trade mark owner. It is argued that these rights fully apply in the digital 3D printing environment.

as the US-style fair use doctrine, or a semi-open exception, but including a more extended list of exception than under the current fair dealing system.[1183]

At the same time, limitations and exceptions must be put in place to exclude from copyright infringement the materialisation of digital objects other than artistic works in order to prevent copyright, and in particular copyright in CAD models, from being used to bar the materialisation of objects that are ineligible for copyright protection. While the qualification of CAD models remains unclear, it is submitted that, at least in South Africa, the standard of originality provides copyright protection for CAD models irrespective of the purpose or nature of the underlying object.

Limitations and exceptions in this context could be mirrored after section 51(1) of the UK CDPA. This section was introduced to exclude functional industrial designs from copyright under the (then) complimenting copyright and designs regimes.[1184] In particular, this section excludes from copyright infringement in a design drawing, *e.g.* a CAD model, the making of an article to the design, or the copying of an article to the design, in as far as the design does not relate to an artistic work.[1185] In this case, recourse must be sought based on the (un)registered design right.

However, where such limitations are in place, it is imperative that the law provides indirect liability mechanisms within the law of trade marks, designs, and patents to close the enforcement gap in the digital environment. Preventing rights holders of objects that fall outside the scope of copyright to rely on the CAD models to enforce their rights would otherwise completely deprive them from any enforcement mechanism in the digital environment.

ii. Indirect Infringement

The enforcement gap within designs and patent law necessitates the implementation of effective means for enforcement within the digital environment. In accordance with the recommendations by the European Commission in the 'Legal Review on

[1183] The approach of 'opening up' fair dealing has been proposed by several scholars. P Jaszi, M Carroll, S Flynn, M Palmedo, K Weatherall and A Katz, 'Evaluating the Benefits of Fair Use: A Response to the PWC Report on the Costs and Benefits of "Fair Use", Report submitted to the Australia Productivity Commission (2016, 15 April) <https://papers.ssrn.com/abstract=2773646> accessed 30 November 2018. In favour of such an approach in the EU: M Lambrecht and J Cabay, 'Remix Allowed: Avenues for Copyright Reform Inspired by Canada' (2016) 11(1) JIPLP 21.
[1184] See 3.1.2.3 – United Kingdom.
[1185] Or typeface. For a detailed discussion see 5.4.1 – Copyright-Design.

Industrial Design Protection in Europe',[1186] the preferable solution, in as far as designs law is concerned, entails the introduction of a provision granting the owner of a design certain rights in relation to the respective design documents.

The real impact of consumer 3D printing on patent law is negligible at this time, and the need for legislative intervention is less pressing. Furthermore, the law arguably already provides for a mechanism of enforcement under the theory of indirect infringement. However, there remains uncertainty as to when providing CAD models amounts to indirect infringement, and it is suggested that the lawmaker introduces a provision that prohibits the use of CAD models that enable the manufacturing of patented objects to avoid any uncertainty.

iii. Intermediary Liability

Parallel to safeguarding the interest of the rights holders and consumers, the legislator must consider the crucial dual role of intermediaries and address the conflict of liabilities. Notwithstanding the controversy that surround it, the notice and take down system works reasonably well and largely enables the consumer 3D printing ecosystem. However, at least under the DMCA, platforms that are hosting designs are only excluded from liability in as far as copyright is concerned. While the outcome might differ under the ECT Act, it is recommended that the legislator ensures that immunities from liability are provided for within the law of trade marks, designs and patents. Such a system would avoid considerable litigation regarding the rights and responsibilities of these design sharing platforms and prevent potential chilling effects as a result of their potential liabilities.

7.2.2 – The Dynamic Between Consumers, Rights holders, and Intermediaries

> Those who cannot [learn from] the past are condemned to repeat it.[1187]

There is no reason for industries affected by consumer 3D printing to repeat the same mistakes made by the entertainment industry. Apart from lobbying for more restrictive legislation and more aggressive enforcement, it is submitted that the current dynamics within the consumer 3D printing ecosystem provides a foundation

[1186] Dumortier (n 20).
[1187] G Santayana, *The Life of Reason: Or, the Phases of Human Progress*, vol 1 (C Scribner's Sons 1905) 284.

for new business models and mutually beneficial approaches towards intellectual property infringement.

Design sharing platforms are the gatekeepers, and it is imperative that they apply a balanced approach when enforcing rights holders' interest, for example, by considering exceptions and limitations that could apply when receiving take down notices. They should also implement a DRM system that permits follow-on creation and clearly communicate the extent to which a digital model can be used and adapted. In particular, licences must clearly state the extent to which digital models can be processed, sliced, and ultimately materialised. Creative Commons licensing is set to continue playing a key role, albeit supplemented by other licensing schemes. The Creative Commons licensing scheme does currently not apply to design rights, patent rights and trade marks, and it is therefore suggested that a standardised open licensing system is developed and implemented that allows for the effortless licensing of trade mark, design and patent rights.

No technological approach seems fit to fully prevent intellectual property infringement, and rights holders of 3D printable content must understand the volatile legal landscape in order to safeguard their intellectual property interests. They should be aware of potential demands for dissemination and customisation of their designs, carry out an analysis of the potential risks of 3D printing to their business, and develop an adequate response. There is no one-size-fits-all approach, and the response by rights holders should depend on the actual situation including competition, the type of content, actual consumer demand, risk of unauthorised dissemination; however, the response should be clear to all stakeholders, including the 3D printing community, consumers and intermediaries.

It is suggested that rights holders and design sharing platforms adopt a situation-based approach, and explore co-operative, non-litigious solutions that enable consumer 3D printing. Instead of emphasising enforcement and using, for example, the notice and take down system to halt digital design dissemination, rights holders should explore licensing agreements that allow, within clear boundaries, for the dissemination and materialisation of the respective design—be it for free or at a cost. While recognising the situation specificity of this approach, it reaffirms rights holders control and economic benefits, while enabling consumer use and creativity. Thus far, we have seen that the implementation of this model is feasible within the

physical dissemination model and there is no reason that would prevent its implementation with regards to digital dissemination.[1188] This said, this system requires cooperation from users, rights holders and design sharing platforms.

7.2.3 – Final Remarks

A functional intellectual property system is crucial for protecting and promoting creativity and innovation within the context of new technologies such as consumer 3D printing; however, the law can only achieve its goal of promoting creativity and innovation if a fair balance is struck between the interests of the various actors within the consumer 3D printing ecosystem and a holistic and pragmatic approach towards policy making is adopted. While some re-calibration as a result of consumer 3D printing is indeed needed, rights holders should resist the temptation to respond, without reflection, to the increased use of 3D printing as a consumer technology with demands for more protection and an increase in enforcement activity to protect their businesses. Such strategies, if broadly employed, carry the risk of intellectual property being used to hamper the development of the 3D printing within the consumer market—and this would be in contradiction of intellectual property's overarching objective of promoting innovation and creativity. After all, consumer 3D printing should be seen as an opportunity for new business models and increased, mutually beneficial creativity and innovation for the benefit of all of us.

[1188] 6.4.2.6 – Enabling.

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